Index to Volume XX

1908

The Journal of Electricity, Power and Gas

Published by the Technical Publishing Company

San Francisco, California

Index to Volume XX

Illustrated articles are designated by an asterisk (*), editorials by a dagger (†), and industrials by a double dagger (‡).

Authors' Index

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XX. SAN FRANCISCO, CAL., JANUARY 4, 1908 No. 1

HYDRAULIC SLUICING PLANT.

By J. A. YEATMAN.

The following description of an original and unique plant for removing the soil over burden in opening a rock quarry may prove helpful to others. About a year ago, the San Pablo Quarry Company, of Oakland, Cal., secured a large acreage for quarry purposes near Richmond, Cal., on San Francisco Bay, and the company was confronted with the problem of removing a deposit of soil and clay ranging from three to twenty feet in depth, covering the faces and levels of the lime rock formation that was to be handled. It was decided the best and cheapest way to remove this soil deposit was to sluice it

PRELIMINARY LAY-OUT OF DITCHES

down to lower level where it would be a benefit, as well as preparing the quarry for active operation.

The general contour of the property is shown in the sketch plan herewith and the elevations may be readily noted from the cross section drawing. The work to be performed, consisted of removing the entire soil deposit from the 105 foot level to the top of the hill on the 200 foot level, comprising a strip of ground some 400 feet wide and 700 feet long, averaging about eleven feet deep and containing about 120,000 cubic yards of material. Further, this material was to be transported some 500 feet and deposited within set lines and brought to grade. Being aware that sluice runs on steep grades would carry from fifteen to twenty per cent solid material in solution, it was estimated that to do the work in 100 days it would require a pumping plant having a capacity of about 100 miners' inches of water.

Having decided upon the method and size of the unit, there were still three problems to solve before work could begin. The first was to secure an electric driven pump that would successfully operate through the wide range of varying head conditions; the second was to lay off the hillside so as to get the best results from the giant, and the third was to provide an impounding reservoir for 120,000 cubic yards of material.

The pump was purchased of the United Iron Works of Oakland, Cal., the same to have a capacity of 950 gallons per minute and to operate against a head of 150 to 250 feet without change of capacity while operating at a constant speed of 850 revolutions per minute, and not to require more than 100 horse-power at any time under any set of head conditions between 150 and 250 feet. The pump, a seven inch, twenty-one inch runner, three step pressure type, direct connected to two Westinghouse fifty horse-power, sixty cycle three phase, 440 volt induction motors; one placed on each side of the

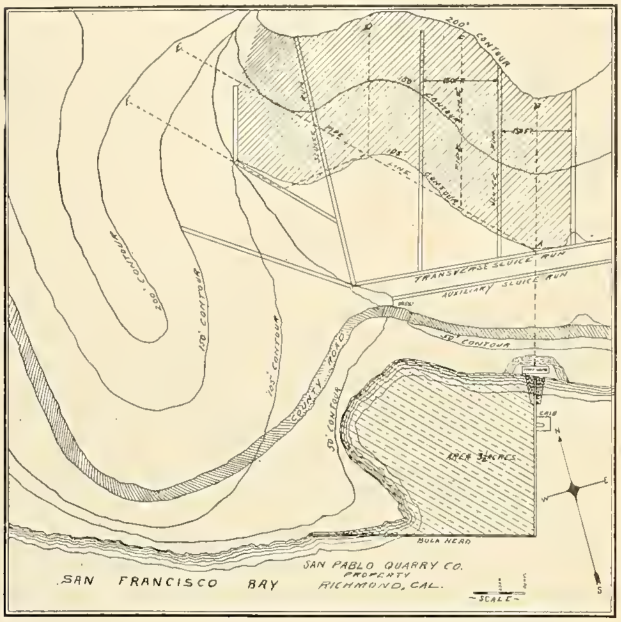
GENERAL VIEW OF WORK DONE

pump and direct connected thereto by means of solid couplings. The pump was fitted with check and relief valve for protection against water ram. The suction was eight inch pipe, 190 feet of which was nearly horizontal, dropping only two feet in this distance, when it turned directly downward into the water fourteen feet, and provided with foot valve to maintain priming. The pump was placed on a prepared shelf on the shore line ten feet above high water, and at low tide the suction head on the pump was eighteen feet when the entrance and pipe losses were added. The discharge pipe line consisting of nine inch riveted and dipped steel slip joint, led directly up the hillside at an angle of about thirty degrees to the giant, which was started on the 105 foot level, as illustrated in cross section and cut showing location of plant.

The plan of operation on the hillside consisted of a number of parallel ditches for sluice runs, placed 150 feet apart, and a transverse ditch leading down the hillside to the impounding bulkheads; an auxiliary ditch was placed some thirty feet below the main transverse ditch as a precaution in the event the working ditch became congested. These ditches were eighteen inches wide and nine inches deep, and made

sure the lines of action. It was not long, however, before they had eroded to bedrock and some places in the main sluice run were fully ten feet deep, and as the clay was so hard, the sides stood almost perpendicular.

The giant played against the face of the soil banks, having a range of seventy-five feet on each side; when a distance of forty feet up the hillside had been washed away, the pump was stopped and the giant was moved up two lengths of twenty foot slip joint pipe and the operation repeated until the top of the hill was reached. During the last setting of the giant the pressure gauge on the pump would register ninety-seven to 100 pounds. The general plan of the main sluice ditches is shown on the contour plat; the line A B shows the first run of pipe, A C the second and so on. One of the cuts shows the sluice ditches before actual sluicing work began.



SAN PABLO QUARY ~ SECTION OF PROPERTY SHOWING SCHEME OF LAYOUT.

For impounding the material washed from the hillside, a bulkhead was constructed; advantage was taken of the natural site, and one line was run southward some 300 feet, and thence at right angles 500 feet to the projecting point, thus enclosing an area of about three and one-half acres. As the part enclosed could be filled to a depth of eighteen feet, it was of ample size to hold all the material to be brought down. It may be noted in illustration, that the surface of the impounded material took a final grade of three feet to 100 and uniformly spread out over the entire area without further attention than providing the site.

In considering the amount of material removed as compared with the amount of water handled, we find that there was 1134 cubic feet of material brought down every hour, and on the basis of 975 gallons per minute, the capacity of the pump, we find that 7800 cubic feet of water was handled per hour. This shows a fifteen per cent solution, which is considered remarkable when it is remembered that a large portion of the ground was so stiff as to require blasting to loosen up the same. The blasting gang is shown in one of the illustrations. The high percentage argues well for capacity, as one cannot well conceive that less water in such material could possibly accomplish so much work.

HYDRAULIC GIANT ON 200 FT. LEVEL

Work was begun in the early part of September, 1906, and continued regularly until the middle of February, 1907, embracing 120 days actual working time, as revealed by the table, with the exception of the February record.

The table shows the lost and running time the electric current paid for each month, the working head, and the divisions of power as called for by the installations.

7" - 21" 3 STEP UNITED IRON WORKS CENTRIFUGAL PUMP

direct connected to

2-50 H. P. 3 PHASE WESTINGHOUSE CCL MOTORS

Lost Time	Sept. 1906	Oct. 1906	Nov. 1906	Dec. 1906	Jan. 1907
Repairs	Day Hr. Min.	Day Hr. Min.	Day Hr. Min.	Day Hr. Min	Day Hr. Min.
Hydraulics	80 10	1 35	5 50	113 50	56 10
Electric	7 35	2 20	0 30	0 40	0 00
Low Tide	27 20	112 00	137 35	117 20	125 35
No Power	3 40	3 10	10 20	2 35	4 45
Moving Giant	15 55	19 00	22 10	33 05	23 20
Total Lost Time	6 20 40	5 18 5	7 8 25	11 3 30	8 17 50
Actual Running Time	16 3 20	25 5 55	22 15 35	19 20 30	22 6 10
Total K. W. Hours	29750	47500	41130	33700	40500
Average K. W. Del to Trans.	76.8	78.4	75.6	70.7	75.8
Average Head Ft.	198	197	180	191	207
Average H. P. Del. to Line	97.8	98.8	95.2	89.1	95.5
Average H. P. Del. to Motor	94.9	95.8	92.3	86.4	92.6
Average H. P. Del. to Pump	82.1	82.9	79.8	74.8	80.1
H. H. P. Output of Pump	50.3	50.1	45.9	48.7	52.8
Efficiency Unit	53.0	52.3	49.7	56.4	57.0
Efficiency of Pump	61.3	60.5	57.6	65.1	65.9

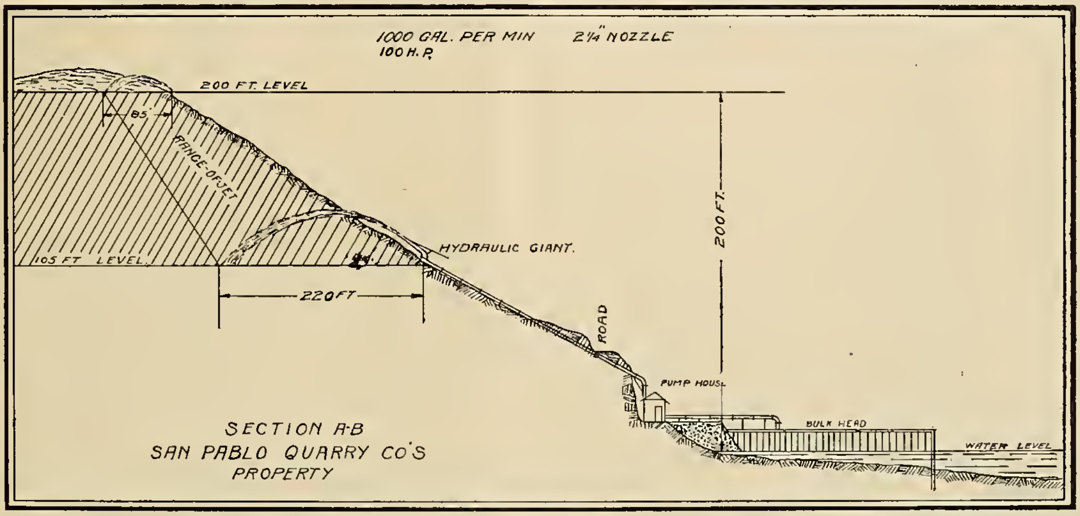
Remarks.—December, 1906, broke pump shaft; 97 hours delay.
Efficiency of Transformer, 94 per cent.
Efficiency of Line, 97 per cent.
Efficiency of Motors, 86.5 per cent.
Capacity, 975 Gallons per minute.
Head determined by gauge on pump read every two hours during operation.
Speed, 870 revolutions per minute.

The cost of operation consisted of 220,180 kilowatt-hours at a commercial rate of one and one-half cents per kilowatt-hour would amount to $3,302.70, plus the cost of six men, who handled the giant in two hour turns on eight hour shifts through the twenty-four hours, including a superintendent at a cost of $19 per day for 174 days, would amount to $3303.00, making a cost of five and one-half cents per cubic yard for the material handled. To this should be added the first cost of the plant and the installation, which is estimated at three and one-half cents per cubic yard, making a total net cost of nine cents per cubic yard for the entire material handled.

From an engineering point of view, the above table of performance reveals the following facts: That the average horse-power plant input was 101.5, and that the average losses were as follows: Transformers, six horse-power, line, three horse-power, motors, thirteen horse-power, pump, thirty-one horse-power, or a total of fifty-three horse-power loss against an average of fifty horse-power theoretic work.

A closer examination of the table shows that the pump loss the first month was 31.8 horse-power; second month, 32.8 horse-power; third month, 33.9, or an increasing loss of one horse-power for each month, while the loss for the fourth month was only 26.1 horsepower. This difference of five or six horse-power loss was probably due to the brake action of imperfect alignment and hydraulic leak caused thereby, for when the new shaft was put in, it is observed the operative conditions were much improved. This shows a loss of something less than nine horse-power for each runner of the three embraced in the pump, which is considered normal loss for a single pump runner when handling fresh water. What loss was incurred by the incrustation on the cast iron runners caused by the salt water is problematical. That it was considerable is manifest, as an examination of the runners a short time after they were put in operation shows that the incrustation was about one-sixteenth of an inch in thickness, and the entire surfaces of the runners were very rough.

Another feature worthy of note from this record is continuous performance, is the uniform loading under a variable head condition, as manifest from an examination of the illustrations herewith showing the work done. The average pumping head is quite uniform and remarkable considering the actual varying location of the giant, and can only be explained by the uniform constant capacity of the pump.



SECTION A-B
SAN PABLO QUARRY CO'S
PROPERTY

ENERGY TRANSFORMATIONS FROM THE ELECTRICAL ENGINEERS' STANDPOINT.*

By H. M. Hobart.

Electrical engineers are chiefly concerned with three forms of energy, namely: heat energy, electrical energy, and mechanical energy.

When energy manifests itself in the form of heat energy, it is convenient to call it briefly "heat"; when in the form of electrical energy, it may be called "electricity." Finally, when in the form of mechanical energy, it may be called "work."

Unit of Energy—The quantity of energy when in any of these forms, may be expressed in kilowatt-hours.

Kilowatt-Hour—The most frequently occurring occasions when we must express energy quantitatively are those on which it is being transformed from one kind into another, as, for instance, from electricity into heat. The kilowatt-hour is one thousand watt-hours. The watt-hour is the quantity of electricity which is transformed into heat in a wire of one-ohm resistance when a current of one ampere flows through it for one hour. As a potential difference of one volt is required to produce a current of one ampere in a circuit of one-ohm resistance, one watt-hour is equal to one volt-ampere hour for continuous current or alternating current at unity power-factor. It is, however, to be noted that in heavy electrical engineering the watt-hour is an inconveniently small quantity and the kilowatt-hour is more convenient, and is thus taken as the unit of energy.

In the illustrative examples which are to follow, it will appear that even the kilowatt-hour is often an inconveniently small unit, for in some departments of heavy electrical engineering, undertakings involving millions of kilowatt-hours are dealt with.

It has been customary in England to denote this quantity of electrical energy as one "Board of Trade Unit," since it is a unit which has been officially adopted by the British Board of Trade, and it is still frequently expressed in this way. It is, however, more often expressed as one kilowatt-hour.

When no ambiguity is thereby introduced, it is often customary briefly to designate this quantity of energy as one "unit"; but this course is not to be recommended, as the term "unit" should be reserved for use in its more general sense.

In this article the following terms are used in dealing with quantities of energy:

*Electrical Review.

1 watt-hour.

1 kilowatt-hour = 1,000 watt-hours.

Weight and Volume—The weight of one cubic meter of water at a temperature of four degrees is termed one ton.

1 ton = weight of one cubic meter of water.

1 ton = weight of 1,000 cubic decimeters of water.

1 ton = weight of 1,000 liters of water.

1 ton = 1,000 kilogrammes.

1 ton = 1,000,000 grammes.

Pressure—The unit of pressure is one kilogramme per square centimeter. When not otherwise expressly stated, absolute pressures are to be understood. That is to say, pressures are referred to an absolute vacuum and not to atmospheric pressure.

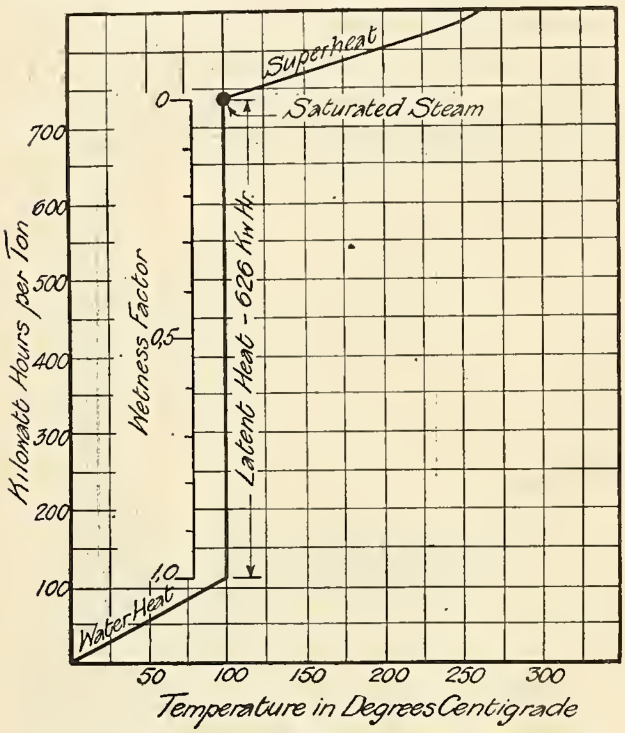


Fig. 1.—Relation between Heat and Temperature for Water and Steam at Atmospheric Pressure.

Relation Between Heat and Temperature.

The relation between heat and temperature for water and steam may be illustrated by means of the curves in Fig. 1, which represent the occurrences attending the absorption of energy by one ton of water, i. e., the "heating" of one ton of water. During the entire operation, the specific pressure is maintained constant at one kilogramme. The curve consists of three distinct portions. The first portion, marked "Water Heat," slopes upward. The second portion, marked "Latent Heat," is vertical. The third portion, which is marked "Superheat," is slightly curved, but its general character is very similar to that of the first portion.

The first portion of the curve represents the heating of water at atmospheric pressure. For all practical purposes the line is straight, since the rise in temperature is closely proportional to the heat added.

A consideration of the extent of the deviation from a straight line must necessarily be prefaced by a discussion of the "Specific Heat." The meaning of the term "Specific Heat" may be illustrated by an example: At eighty degrees, 1,172 kilowatt-hours are required to raise the temperature of one ton of water by one degree. The corresponding amount of energy required to raise by one degree the temperature of one ton of water at zero degrees is only 1,160 kilowatt-hours. The specific heat of water at eighty degrees is obtained by dividing 1,172 by 1,160, and is consequently equal to 1.010. The quantity of energy, 1,160 kilowatt-hours, which is absorbed in raising the temperature of one ton of water from zero degrees to one degree is the standard of reference as regards specific heat, since water at zero degrees has been chosen as the standard substance, and its specific heat at that temperature is taken as unity.

The specific heat of any body at any temperature is obtained in the above manner by dividing the kilowatt-hours required to cause a rise of temperature of one degree by 1,160, as this is the energy in kilowatt-hours required to raise one ton of water at zero degrees by one degree.

The values of the specific heat of water at various temperatures are given in Table I.

TABLE I.

The Specific Heat of Water at Various Temperatures.

Temperature in Degrees Centigrade.	Specific Heat	Energy in Kilowatt-Hours Required to Raise One Ton of Water by One Degree Centigrade
0	1.000	1,160
20	1.001	1,161
40	1.003	1,163
60	1.006	1,167
80	1.010	1,172
100	1.013	1,175
120	1.018	1,181
140	1.023	1,187
160	1.029	1,193
180	1.036	1,202
200	1.044	1,211

When at atmospheric pressure a ton of water has been brought to a temperature of 100 degrees, the absorption of additional energy does not cause a further rise in temperature until this additional energy has amounted to 580 kilowatt-hours. Consequently the second portion of the curve in Fig. 1 is a vertical line of a length corresponding to 626 kilowatt-hours.

The heat thus required to be added before any further rise in temperature is occasioned is called the "latent heat" of the water, or the latent heat of vaporization or evaporation of water.

The energy corresponding to the latent heat may be divided into two components. The first component represents the energy necessary to change the molecular state, and is termed the internal latent heat. The second component represents the energy required to expand the water against the surrounding pressure from its liquid volume to its gaseous volume, i. e., to its volume when converted into steam. This component is much smaller than the first component. It is termed the external latent heat, and ranges, according to the specific pressure, from six per cent to ten per cent of the total latent heat.

If, instead of atmospheric pressure, other pressures are maintained during the conversion of one ton of water into steam, the latent heat, as well as its two components, has other values. These are given in Table II for a number of different pressures. In the second column of the table are given the corresponding temperatures at which vaporization occurs.

TABLE II.

Table of the Internal and the External Latent Heat of Vaporization of Water.

Absolute Pressure in Kg. per Sq. Cm.	Temperature of Vaporization in Degrees Centigrade.	Latent Heat of Vaporization in Kilowatt-Hours per Ton. Internal.	External.	Total.
1	99	579	47	626
2	120	563	49	612
4	143	541	51	592
8	170	518	53	571
12	187	502	54	556
16	200	487	55	542
20	211	475	56	531

Prior to the absorption by the ton of water at vaporization temperature, of the entire amount of energy correspond-

ing to its latent heat, the ton of water will not have been converted entirely into steam, but will be a mixture of water and steam. At atmospheric pressure the latent heat of one ton of steam is 626 kilowatt-hours. When only half of this quantity of energy, i. e., when only 313 kilowatt-hours have been absorbed, we shall have a mixture consisting of 0.5 ton of water and 0.5 ton of steam. To the diagram in Fig. 1 has been added a scale showing the "wetness" of the steam at various stages of the process of imparting 626 kilowatt-hours to the ton of water. At the commencement of the

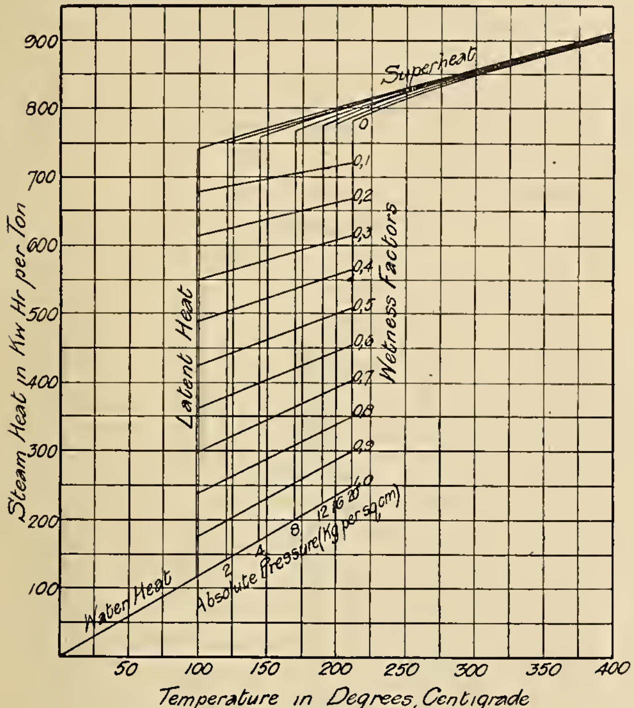


Fig 2.—Relation between Heat and Temperature for Water and Steam at Various Pressures.

process the "wetness" is 100 per cent, or we may say that the steam has a wetness factor of 1.00. When 125 kilowatt-hours have been absorbed the wetness factor is 0.80, and when the entire 626 kilowatt hours have been absorbed, the wetness factor is 0.00 and we have so-called "saturated" steam.

Further additions of heat are accompanied by increase of temperature, and the steam is said to be "superheated." This part of the process corresponds to the right-hand sloping portion of the diagram in Fig. 1. The angle at which this portion of the diagram slopes upward is dependent upon the specific heat of superheated steam.

The specific heat of superheated steam varies considerably with the temperature and pressure. It is, roughly, about half of that of water. Hence a given quantity of energy imparted to a ton of steam will raise its temperature through about twice as many degrees as the same amount of energy imparted to one ton of water.

These data are embodied in the diagrams in Fig. 2, where are drawn, for various pressures, a set of lines corresponding to those already given in Fig. 1 for an absolute pressure of one kilogramme per square centimeter.

The leading properties of steam are entered up in Tables V, VII and VIII. At the present time considerable difference of opinion exists among physicists with regard to the values of the specific heat of superheated steam at various temperatures and pressures. The values employed in the construction of Tables V, VII and VIII are in accord with those given by Mollier in his brochure entitled "Neue Tabellen und Diagramme fur Wasserdampf."

Mollier's values for the specific heat of steam are given in Table III. The values given in this table represent the average specific heat while the temperature of the steam is raised from the temperature of vaporization to various final temperatures.

The specific heat and specific gravity of some common materials are given, together with the kilowatt-hour per ton per degree centimeter temperature rise, in Table IV.

Examples of the Amount of Energy Represented by One Kilowatt-Hour.

1. One kilowatt-hour is sufficient to lift one ton through a height of 367 meters.

2. One kilowatt-hour is consumed at the trolley in propelling a ten-ton tram-car of good design on a good and level track for a distance of from one to two kilometers or thereabouts (according to the number of stops per mile), at a schedule speed of some twelve kilometers per hour.

3. One kilowatt-hour is absorbed in eighty-four hours by a twelve-candlepower lamp requiring one watt per candlepower. If the lamp is only in circuit for an average period of four hours per day, 17.4 kilowatt-hours will be absorbed by the lamp in the course of one year, provided that it survives for 1,660 hours in circuit with an average efficiency of one watt per candlepower and that its candlepower does not alter.

If the charge is six cents per kilowatt-hour, the cost of energy for this lamp will amount to $(1{,}660 \times 6) = 104$ cents for the year. Replacing the lamp once a year at a cost of forty-eight cents brings the total annual outlay per lamp to

$$\$1.04 + 0.48 = \$1.52.$$

To this must also be added an equitable proportion of the meter rental. On these assumptions the lamp thus costs a matter of $1.60 per year.

4. The latent heat of liquefaction of ice is ninety-three kilowatt-hours per ton; that is to say, to convert one ton of ice at zero degrees into one ton of water at zero degrees requires the application of ninety-three kilowatt-hours.

TABLE III.

Table of the Average Specific Heat of Steam Heated from the Temperature of Vaporization at Various Final Temperatures

Absolute Pressure in Kg. per Sq. Cm.	0.1	0.5	1	2	4	6	8	10	12	14	16
Temperature of Vaporization in Deg. Cent.	46	81	99	120	143	158	170	179	187	194	200
Final Temperature of Steam in Deg. Cent. 100	0.480	0.490	0.501	.....	.....	.....	.....	.....	.....	.....	.....
150	0.479	0.488	0.495	0.513	0.533	.....	.....	.....	.....	.....	.....
200	0.479	0.486	0.491	0.505	0.523	0.538	0.558	0.573	0.588	0.601	.....
250	0.479	0.484	0.489	0.500	0.514	0.528	0.543	0.556	0.569	0.578	0.588
300	0.479	0.483	0.487	0.496	0.508	0.519	0.531	0.541	0.551	0.562	0.569
350	0.479	0.482	0.485	0.493	0.503	0.513	0.522	0.531	0.539	0.547	0.555
400	0.478	0.482	0.484	0.491	0.500	0.508	0.517	0.523	0.531	0.538	0.545
450	0.478	0.482	0.483	0.489	0.497	0.505	0.513	0.519	0.525	0.531	0.537

TABLE IV.

Material.	Specific Gravity (Tons per Cu. M.)	Specific Heat.	Kilowatt-Hours Required to Raise the Temperature of One Ton by One Degree.
Water	1.0	1.0	1.16
Ice	0.93	0.49	0.57
Coal	1.3	0.24	0.28
Wrought Iron	7.7	0.11	0.13
Cast Iron	7.2	0.13	0.15
Copper	8.9	0.10	0.12
Lead	11.4	0.03	0.035
Zinc	6.9	0.09	0.11
Transformer Oil	0.9	0.75	0.97

TABLE V.

Table of the Energy in Kilowatt-Hours Required to Convert One Ton of Water at Zero Degrees Centigrade into Steam at Various Pressures and Superheats.

Absolute Pressure in Kg. per Sq. Cm.	Temperature of Vaporization in Deg. Cent.	Heat in Kilowatt-Hours per Ton. Component Parts. Water Heat.	Latent Heat.	50 Deg. Cent. Superheat.	100 Deg. Cent. Superheat.	150 Deg. Cent. Superheat.	Total Steam Heat. Saturated Steam.	Steam Superheated 50 Deg. Cent.	Steam Superheated 100 Deg. Cent.	Steam Superheated 150 Deg. Cent.
A	B	C	D	E	F	G	H	K	L	M
0.02	17	20	680	28	55	83	700	728	755	783
0.04	29	32	670	28	55	83	704	732	759	787
0.06	36	42	667	28	55	83	709	737	764	792
0.08	41	48	665	28	55	83	713	741	768	796
0.10	46	53	663	28	55	83	716	744	771	799
0.12	49	57	660	28	56	84	717	745	773	801
0.15	54	63	657	28	56	84	720	748	776	804
0.20	60	70	654	28	56	84	724	752	780	808
0.25	65	75	650	28	56	85	725	753	781	810
0.30	69	80	647	28	56	85	727	755	783	812
0.35	72	84	645	28	56	85	729	757	785	814
0.40	76	88	642	28	56	85	730	758	786	815
0.50	81	94	639	28	56	85	733	761	789	818
0.60	86	100	636	28	56	85	736	764	792	821
0.70	90	104	633	29	57	86	737	766	794	823
0.80	93	109	630	29	57	86	739	768	796	825
0.90	96	112	628	29	57	86	740	769	797	826
1.0	99	115	626	29	57	87	741	770	798	828
1.1	102	118	625	29	57	87	743	772	800	830
1.2	104	120	623	29	57	87	745	774	802	832
1.4	109	127	619	30	58	88	746	776	804	834
1.6	113	132	616	30	58	88	748	778	806	836
1.8	116	136	614	30	58	88	750	780	808	838
2.0	120	140	612	30	58	88	752	782	810	840
2.5	127	148	606	30	59	89	754	784	813	843
3.0	133	155	601	30	59	89	756	786	815	845
3.5	138	162	596	30	59	89	758	788	817	847
4.0	143	167	592	31	60	90	759	790	819	849
4.5	147	172	589	31	60	90	761	792	821	851
5.0	151	177	587	31	61	90	764	795	825	854
5.5	155	182	584	31	61	91	766	797	827	857
6.0	158	186	581	31	61	91	767	798	828	858
6.5	161	189	578	32	62	92	767	799	829	859
7.0	164	193	575	32	62	92	768	800	830	860
7.5	167	196	573	32	62	92	769	801	831	861
8.0	170	199	571	32	62	92	770	802	832	862
8.5	172	202	569	32	62	92	771	803	833	863
9.0	174	205	566	33	63	93	771	804	834	864
9.5	177	208	564	83	63	93	772	805	835	865
10.0	179	211	562	33	63	93	773	806	836	866
11.0	183	216	559	33	63	93	775	808	838	868
12.0	187	220	556	33	64	94	776	809	840	870
13.0	191	225	552	33	65	95	777	810	842	872
14.0	194	229	549	33	65	96	778	811	843	874
15.0	197	233	545	34	66	97	778	812	844	875
16.0	200	237	542	34	66	97	779	813	845	876
18.0	206	244	536	35	67	98	780	815	847	878
20.0	211	250	531	35	68	99	781	816	849	880

5. The specific heat of ice is 0.49. Consequently to convert one ton of ice at —8 degrees into water at zero degrees requires the application of 97.6 kilowatt-hours, this amount being accounted for as follows:

Four and six-tenths kilowatt-hours are required to raise the temperature of the ice to zero degrees, and ninety-three kilowatt-hours are required to liquefy the ice.

6. To convert one ton of ice at —8 degrees into water at +8 degrees requires the expenditure of 107 kilowatt-hours, this amount being accounted for as follows: As in Example 5, 97.6 kilowatt-hours are required to change the ice into water at zero degrees, and a further 9.3 kilowatt-hours to raise the temperature of the water to eight degrees.

7. The average specific heat of transformer oil is 0.75, of copper 0.1, of iron 0.11. In a certain transformer the weight of the copper is 100 kilogrammes, the laminations 200 kilogrammes, the cast-iron case 150 kilogrammes, and the oil 180 kilogrammes. The internal loss amounts to one kilowatt and it is required to find the time required to cause a rise of temperature of forty degrees, assuming that the heat is exclusively employed in causing a rise of temperature and that none is radiated from the external surface of the frame.

The oil requires $0.75 \times 1.16 \times 0.18 \times 40 = 6.3$ kilowatt-hours. Similarly the copper requires 0.46 kilowatt-hours, the laminations one kilowatt-hour, and the frame 0.75 kilowatt-hour. The total heat required is 8.5 kilowatt-hours, so that if the losses in the transformer are one kilowatt, the time would be 8.5 hours, under the conditions set forth.

Energy Transformations.

Electrical energy, or, briefly, electricity, can be transformed into work energy—or work with an efficiency as high as ninety-five per cent in large motors. Work may be trans-

TABLE VI.

Heat Energy in Kilowatt-Hours Rendered Available for Conversion into Mechanical Work by the Expansion of One Ton of Steam.

Exhaust Pressure in Kg. per Sq. Cm.	Admission Pressure in Kg. per Sq. Cm.: 16			14				12				10				8				7			
Admission Temperature in Degrees Centigrade.	200	250	300	194	200	250	300	187	200	250	300	179	200	250	300	170	200	250	300	158	200	250	300
0.05	228	243	261	225	226	241	256	219	223	236	250	211	217	230	242	202	209	222	234	191	200	212	226
0.1	210	224	240	205	208	220	238	199	204	215	238	190	197	208	222	180	188	199	214	170	179	190	203
0.2	188	200	214	183	185	197	210	176	179	190	204	168	174	182	197	158	165	174	187	146	154	163	177
0.4	162	175	188	158	154	172	183	151	153	165	176	144	148	157	169	133	139	148	160	122	129	137	150
0.6	148	160	173	143	144	155	168	137	139	150	161	127	132	142	153	118	123	132	143	105	112	121	132
0.8	138	147	160	132	132	144	154	125	128	138	147	117	120	130	140	107	111	120	130	95	100	108	120
1.0	128	139	152	123	123	134	146	116	119	128	128	108	112	120	130	97	102	110	119	85	90	99	109
1.5	114	122	133	106	108	118	128	100	102	111	120	91	94	102	111	80	83	92	101	67	72	79	90

Heat energy (in kw.-hr per ton) available for conversion into work.

Note.—The values for steam initially saturated are set in heavier type.

TABLE VII.

Table of Specific Volume and Specific Weight of Saturated and Superheated Steam.

Absolute Pressure in Kg. per Sq. Cm.	Temperature of Vaporization in Deg. Cent.	Specific Volume in Cu. M. per Kg.: Saturated Steam	Steam Superheated 50 Deg. Cent.	Steam Superheated 100 Deg. Cent.	Steam Superheated 150 Deg. Cent.	Specific Weight in Kg. per Cu. M.: Saturated Steam.	Steam Superheated 50 Deg. Cent.	Steam Superheated 100 Deg. Cent.	Steam Superheated 150 Deg. Cent.
A	B	N	O	P	Q	R	S	T	U
0.02	17	68.0	81.0	93.0	105.0	0.015	0.012	0.011	0.010
0.04	29	35.0	42.0	48.0	54.0	0.028	0.024	0.021	0.019
0.06	36	24.0	28.0	32.0	36.0	0.042	0.036	0.031	0.028
0.08	41	18.0	21.0	24.0	27.0	0.055	0.047	0.041	0.037
0.10	46	15.0	17.0	20.0	22.0	0.066	0.058	0.051	0.046
0.12	49	12.0	15.0	17.0	19.0	0.081	0.069	0.061	0.054
0.15	54	10.0	12.0	13.0	15.0	0.100	0.085	0.075	0.067
0.20	60	8.0	9.0	10.0	11.0	0.130	0.112	0.099	0.089
0.25	65	6.4	7.3	8.3	9.2	0.16	0.14	0.12	0.11
0.30	69	5.3	6.1	6.9	7.7	0.19	0.16	0.14	0.13
0.35	72	4.6	5.3	6.0	6.6	0.22	0.19	0.17	0.15
0.40	76	4.0	4.6	5.3	5.9	0.25	0.22	0.19	0.17
0.50	81	3.3	3.8	4.3	4.7	0.31	0.26	0.24	0.21
0.60	86	2.8	3.2	3.6	4.0	0.36	0.31	0.28	0.25
0.70	90	2.4	2.8	3.1	3.4	0.42	0.36	0.32	0.29
0.80	93	2.1	2.4	2.7	3.0	0.48	0.41	0.37	0.33
0.90	96	1.9	2.2	2.4	2.7	0.53	0.46	0.41	0.37
1.0	99	1.7	2.0	2.2	2.4	0.59	0.51	0.45	0.41
1.1	102	1.6	1.8	2.0	2.2	0.64	0.56	0.50	0.46
1.2	104	1.4	1.7	1.9	2.1	0.70	0.60	0.54	0.49
1.4	109	1.2	1.4	1.6	1.8	0.80	0.70	0.63	0.57
1.6	113	1.1	1.3	1.4	1.6	0.92	0.79	0.71	0.64
1.8	116	1.0	1.1	1.3	1.4	1.02	0.89	0.80	0.71
2.0	120	0.89	1.02	1.14	1.26	1.1	1.0	0.9	0.8
2.5	127	0.72	0.83	0.93	1.02	1.4	1.2	1.1	1.0
3.0	133	0.61	0.70	0.78	0.86	1.6	1.4	1.3	1.2
3.5	138	0.52	0.60	0.68	0.74	1.9	1.7	1.5	1.4
4.0	143	0.46	0.53	0.59	0.67	2.2	1.9	1.7	1.5
4.5	147	0.43	0.47	0.53	0.58	2.4	2.1	1.9	1.7
5.0	151	0.37	0.43	0.47	0.52	2.7	2.3	2.1	1.9
5.5	155	0.34	0.39	0.44	0.48	2.9	2.5	2.3	2.1
6.0	158	0.32	0.36	0.40	0.44	3.2	2.8	2.5	2.3
6.5	161	0.29	0.34	0.37	0.41	3.4	3.0	2.7	2.6
7.0	164	0.27	0.31	0.35	0.38	3.7	3.2	2.9	2.6
7.5	167	0.26	0.29	0.32	0.35	3.9	3.4	3.1	2.8
8.0	170	0.24	0.28	0.30	0.33	4.1	3.5	3.3	3.0
8.5	172	0.23	0.26	0.29	0.31	4.4	3.8	3.5	3.2
9.0	174	0.22	0.24	0.27	0.30	4.6	4.1	3.7	3.4
9.5	177	0.21	0.23	0.26	0.28	4.9	4.3	3.9	3.6
10.0	179	0.20	0.22	0.24	0.27	5.1	4.6	4.1	3.8
11.0	183	0.18	0.20	0.22	0.24	5.6	5.0	4.5	4.1
12.0	187	0.16	0.18	0.20	0.22	6.1	5.4	4.9	4.5
13.0	191	0.15	0.17	0.19	0.21	6.5	5.9	5.3	4.8
14.0	194	0.14	0.16	0.18	0.19	7.0	6.4	5.7	5.2
15.0	197	0.13	0.15	0.16	0.18	7.5	6.8	6.1	5.6
16.0	200	0.12	0.14	0.15	0.17	7.9	7.3	6.6	6.0
18.0	206	0.11	0.12	0.14	0.15	8.9	8.2	7.4	6.8
20.0	211	0.10	0.11	0.13	0.14	9.6	8.9	8.1	7.6

formed into electricity with equally high efficiency. The remaining five per cent or more is converted into heat energy or, briefly, into heat. Electricity and work may both be converted into heat with an efficiency of 100 per cent. Thus if an electric current is sent through a resistance, the electrical energy is entirely converted into heat in the resistance. If work is performed in stirring water, as in Joule's experiment, the work energy may be entirely transformed into heat energy. The "generation" of electrical energy in generating stations is strictly the transformation of energy from heat to electricity.

(To be continued.)

UNITED STATES GEOLOGICAL SURVEY HYDROGRAPHIC INVESTIGATIONS.

The United States Geological Survey, in connection with its other activities, has been engaged for the past twelve years in making investigations of the quantity, quality and availability of surface and ground water throughout the United States. The results of these investigations have been published regularly as Water Supply and Irrigation Papers, and have been available for distribution and for reference in libraries throughout the country. The importance of this work and the value to the public of a knowledge of our water resources has led some of the States, private individuals and corporations to co-operate with the Survey in securing the desired information, and the results of many independent measurements and investigations have been placed at the disposal of the Survey and made available for general use by their publication, with the results of the investigations made by the Survey in the Water Supply and Irrigation Papers. The value of this information is by no means limited to the communities in which actual observations are made, as the intelligent study of water yield in various parts of the country under known conditions of precipitation, temperature, altitude, topography and cultivation affords a basis for at least approximate determination of the water resources of other localities where no direct investigations have been made, and if the hydrographic investigations are continued throughout the country under the uniform methods and skilled direction of the Geological Survey, it may ultimately become possible, with the accumulated data covering seasonal and cyclic variations in stream flow, to formulate general laws which will permit a determination of the water yield in localities where the water resources have not been investigated, from the meteorological records of the United States Weather Bureau, and a knowledge of the topography, extent and nature of cultivation and other factors which are readily ascertained.

It hardly seems necessary to draw attention to the absolute impossibility of developing any part of the country without an adequate supply of water of suitable quality. For domestic purposes, for irrigation, for every class of industrial enterprise, a determination of the availability of an ample water supply is the first consideration. We have never heard any question raised concerning the importance of these hydrographic investigations, their value to the people, nor the thoroughness with which the Survey has done its work, within the limitations of the funds available.

These investigations have been continued during the past twelve years, and the appropriations therefor were gradually increased by Congress to $200,000 per annum, which amount was available for four years prior to June 30, 1906. The Committee on Appropriations of the House (59th Congress, 2d Session) disapproved of this work, and claimed that it had no Federal purpose, and should not, therefore, be supported by the Federal Government. The Chairman of the Committee stated that "I do not take issue with the advocates of this appropriation on the question of benefit to the people. The issue which I raise with them is the question of whose duty it is to perform the work." This Committee, in reporting the Sundry Civil bill, made no provision for this work for the year ending June 30, 1907. An attempt was made on the floor of the House to introduce an amendment, the result of which would have been to provide a suitable appropriation, but a point of order was raised and sustained.

The Senate later approved an appropriation of $150,000 which, in conference between the Committees of both branches, was reduced to $100,000, and the Survey has, therefore, been obliged to carry on the work during the present year for half the amount previously available. The amount of work performed has been proportionately reduced.

In regard to the point of order sustained in the House, it was alleged that the organic act of the Geological Survey does not make any provision for these investigations, and that, therefore, any appropriation for same is without authority in law, notwithstanding the fact that the work has been continued over a period of twelve years under appropriations of Congress.

The Secretary of the Interior has included in his estimate for the year ending June 30, 1909, the sum of $200,000 for hydrographic investigations of the United States Geological Survey. The attitude of the members of the present Committee on Appropriations on this subject is not known to us, but in view of the precedent established on the point of order at the last session it is manifestly desirable that a bill be passed giving the Survey specific authority to continue these hydrographic investigations, before the appropriation bill comes up for action.

Such a bill (House Bill No. 6122) was introduced on December 9th by Mr. Needham, "to provide for continuation of investigations of the rivers and water resources of the United States," and will presumably be passed upon by the Rivers and Harbors Committee early in January, and soon after acted upon by the House. If this bill is passed there will be no possible legal objections to the appropriation for hydrographic investigations in the Sundry Civil bill, and the item may then be considered by Congress solely upon its merits when this Appropriation bill is taken up later in the session.

"It is manifestly impossible for any individual investigators or corporations to pursue such an extended series of gaugings and studies of the laws governing the water resources of the United States, as is necessary to establish the relations between rainfall, evaporation, temperature ranges and other climatic conditions affecting the water yield of drainage basins in different parts of the country, and where such local investigations are made by private enterprise the information secured does not ordinarily become available to the interested public, except indeed when the data is communicated to the Geological Survey, and combined with the results of their own work in the publication of Water Supply and Irrigation Papers.

"It is equally impracticable for the several States to thoroughly cover these investigations, as there would be such lack of uniformity in methods as to prevent the general application of the data thus independently collected, and in the case of the larger streams which bound or traverse several States the net results would probably be so confusing as to be unsafe for practical use.

"The increasing development of all the natural resources of the country is of course desirable, but in the case of water, which is indispensable to the prosperity and even the existence of every community, the most complete knowledge should be available in order that it may be intelligently and effectively conserved and utilized for power, for irrigation and for municipal water supplies."

This is properly a Federal undertaking, equally with the maintenance of the Weather Bureau, the control of navigable rivers, the institution of forest reserves, the surveying and mapping of the United States and other public works which cannot effectively be undertaken by individuals or the several States. We trust that Congress will appreciate the real value and propriety of this Federal undertaking and the seriousness of even a temporary interruption of the consecutive observations, which are essential to the proper conduct of the work, and that House bill No. 6122 may be favorably reported by the Rivers and Harbors Committee, become law, and that the requested item of $200,000 in the Sundry Civil bill may be favorably reported, and this appropriation thus again become available.

CURRENT COMMENT

An electric forge for sharpening drills is being tested underground at one of the South African mines. If successful, it will avoid overheating and burning the steel, and save the expense and delay of carrying the drills to the surface for sharpening, as well as eliminating smoke.

Any direct current series motor will run with alternating current if undue heating is prevented by proper design of the magnetic field. Sparking caused by the alternating field flux is reduced to a minimum by inserting resistance in the leads between the armature and the commutator segments.

It is claimed that celluloid for accumulator cells can be made incombustible by dissolving it in acetone and, after treatment with phosphate of iron or other salts, adding tetrachloride of carbon and formaldehyde. The celluloid floating on the surface may be dried and molded without any change in its original properties except its inflammability.

The electric furnace at Heroult, Shasta County, Cal., owned by the Noble Electric Steel Company, will be devoted to the production of ferro-silicon and other ferro alloys. D. A. Lyon has recently been appointed general manager for the company, and will be in charge of these operations. Preliminary runs that have been made, have been very successful so far as the economies and the quality of the production is concerned.

A press dispatch from Paris states that Pascal Berjonneau, an inventor, has exhibited before the Postmaster-General and a number of persons interested in scientific investigation a new telephotography apparatus which can be adapted to the wireless system or to the ordinary telegraph wires. He transmitted the picture of the Postmaster-General without the aid of wires from one end of the hall to the other. The inventor claims that distance does not interfere with the effectiveness of his method. Photographs, he says, can be sent by it between New York and Paris.

A new system for the fixation of atmospheric nitrogen devised by A. Moschi uses an arc magnetically deviated. The arc is produced between two concentric carbon rings which act as electrodes. By means of a magnetic field perpendicular to the plane of the rings the arc is deflected and is caused to rotate within the annular space between the two rings. This system is said to have yielded 525 kg. of nitric acid per kw-year. The same method was also used in experiments of Brion, while the Badische Anilin und Soda Fabrik uses a quiet continuous arc several meters in length inclosed within a tube of suitable diameter, the air being passed through the tube from one end to the other. The specific yield of nitric acid is stated to be higher with this arrangement than with the Birkeland-Eyde process.

W. L. Saunders, in a paper presented before the American Institute of Mining Engineers, claims that the electric air drill takes from one-third to one-fourth of the power at the power house, to drive it to do the same work as a simple pneumatic drill. This is accounted for by the fact that the same air is used over and over, and that all of its elastic force is availed of in both directions, instead of exhausting the charge for each stroke at full pressure. There are also no large clearance-spaces to fill anew at each stroke, as these spaces are never emptied. A valuable feature of the electric air drill is the ability to yank the bit free if stuck in a hole and immediately continue its work. At Idaho Springs, Colo., a mine shaft was put down 67 feet in 24 shifts and the total energy cost was $24.00 for the entire work.

Siemens & Halske have been granted a patent for producing homogeneous bodies from tantalum and other highly refractory metals, which consists in heating the oxide in vacuum in an electric furnace, and subjecting the metal to the influence of an electric arc. To produce a plastic mass with wolfram combinations having adhesive properties like those of glue, and which can easily be drawn out in threads, acid ammonium wolframate is heated to dryness in a vessel to obtain disengagement of ammonia. Heating should not be too great, to avoid greater decomposition. The temperature should preferably be below redness—e. g., about 270 degs. C. Heating is continued until the mass acquires a greenish-grey tint, which disappears in cooling, and until no more ammonia is disengaged. The product thus obtained forms, in hot water or after a little boiling in water, a tenacious substance like glue, which can be drawn out in threads, if too much water has not been employed. The threads thus obtained can be profitably used for electric incandescent lamps. When the acid ammonium wolframate is heated in a retort it is well to remove all air by producing an almost complete vacuum in the retort. The material thus produced is very useful as a binding substance for wolfram oxides.

All of the 130 miles of street railway in St. Petersburg are to be electrified within the next six years. The first section, thirty miles in length, has been finished by the Westinghouse Company. For operating this section of the lines a central station has been located upon the Obvodny Canal, where it can receive coal from barges. Three turbine-alternator units placed in the dynamo room, operate at 1,500 revolutions per minute and are rated at 2,200 kilowatts, delivering 6,600 volts at twenty-five cycles. The boiler room contains six double boilers, and the plant is also equipped with a battery of 130 cells of accumulators. Five substations are used for the line, and each of these will have a capacity of 1,000 or 2,250 kilowatts, according to its location. In the substations are installed a set of oil transformers which receive the main current from the central station at 6,600 volts. At the secondaries of the transformers the voltage is 370 volts three-phase. This is used upon rotary converters which supply direct current at 600 volts for the trolley wire. Different capacities, either 500 or 150 kilowatts, are used for the rotaries, and the machines are started up by a small three-phase motor, or else a storage battery which the station contains can be used for starting if need be. The rolling stock used upon the first section consists of 200 motor cars. Each of the cars is fitted with two forty-horse-power motors. The old horse cars may be used as trailers.

MEETING NOTICE.

The Illuminating Engineering Society, at its meeting of December 18, 1907, was addressed by Prof. Puffer, who presented an interesting paper on "The Variables of Illuminating Engineering." Considerable discussion followed, participated in by Prof. Puffer, Prof. Clifford, Dr. Bell, Messrs. Campbell, Codman, Hatch, Ware, Curry and others.

The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
SUCCESSORS TO
The Journal of Electricity Publishing Company
111 New Montgomery St., San Francisco

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

Vol. XX JANUARY 4, 1908 No. 1

EDITORIAL.

PACIFIC POWER REVIEW.

Throughout the whole country this week almost every business man is "taking stock." As this summing up of possessions and elimination of shelf-worn articles is necessary for the successful conduct of every business, so is it of use in understanding our status in engineering development. But while the custom may be commendable, the time most certainly is not auspicious. At the end of the calendar year the statistician is unable to present his complete report, and the reviewer lacks the definite data from which to gain the requisite mental perspective. Even the advantage of intimate acquaintance is not compensating. Necessarily, taking a worm's-eye view of affairs with which we are in closest contact, there is likelihood of our being dazzled by the spectacular advance made in the development of wireless transmission, new incandescent filaments and their ilk, without sensing the steadier illumination produced by the aggregate of more practical and efficient units. Yet this comparison of lines of development is itself comparative, and the introduction of a new function in the variable often reverses its significance. Time's integration will show the unfit of today to be the fit of tomorrow. For the past decade the backers of hydraulic turbines, reciprocating steam engines, gas engines and dynamos have been disputing the relative merits of their machines without reference to the fact that while certain conditions may make one form of motive power far superior to another, yet under different conditions the supremacy is alternated.

There is probably no more notable advance in the face of contending odds than that shown by the upbuilding of the steam turbine. So great has been the effort of brain, brawn and money expended upon this problem, that it has materially weakened the body of the corporation, and some even hint that the succumbing of some of the large manufacturers to the recent financial epidemic was in part due to the attempts to bring forth a commercial steam turbine. But owing to their great recuperative powers, recovery has been rapid, and as a result we now have several types in successful operation.

One strong factor in continued growth of both the turbine and reciprocating engine has been the increased knowledge of the uses and advantages of superheated steam, which, during the past year, has resulted in several changes in engine design with promise of increased efficiency. Steam boilers are undeniably susceptible of great improvement, and this year it has been announced by a competent authority that he can produce ten times the amount of steam at present obtained per square foot of heating surface. This is to be done by improving the combustion chamber as a burner of volatile matter. The steam engine is undoubtedly the most reliable prime mover, working for years without losing a week's time, and still showing the same economy as when first installed. This freedom from breakdown and its sustained efficiency will indefinitely postpone its predicted extinction.

Undoubtedly, much of the improved efficiency of the older forms of power has been caused by the competition of the gas engine with its greater thermal efficiency. There is nothing like the spur of competition to cause improvement in hitherto dormant bodies. The past year has shown that most of the gas engine troubles are due to ignorance of the best working condition. It is often required to work at all sorts of speed, with a great variety of mixtures, and variable points of ignition, together with imperfect elimination of waste products. In a recent paper, Professor Lucke proposes a smooth interior for the ignition chamber with a free entrance for a uniform gaseous mixture regularly supplied, as the best means of averting these troubles. The gas engine is far from perfect yet, but even now it is capable of furnishing power at a low cost. Especially is this true with producer gas, which, though it has received no great development in this country, shows wonderful possibilities as an agent for power, light and heat distribution. The success of the great oil pipe lines in California suggests the possibilities of power by gas over long distances.

Already the largest oil gas plant in the world has been constructed south of San Francisco, in San Mateo County, and, besides supplying gas to the large engines there, the gas is also transmitted twenty-four miles to Redwood City, and four and a half miles to one of the stations of the San Francisco Gas & Electric Company, from which it is delivered

throughout the city. Two compressors, each having a capacity of 5,500,000 cubic feet of gas in twenty-four hours, compress the gas to from fifty to sixty pounds per square inch. This work is somewhat similar to that accomplished years ago by the natural gas men, and it is to them that the progressive gas engineer of today is looking for solution hints. The transmission pipe could be made of any length provided that compressors were placed at suitable points on the line to drive the gas through the next section. The attractive possibilities of extensive gas transmission affords a fertile field for an active imagination.

The claim that the gas engine is applicable only to small units is refuted by the success of the greatest gas engine plant of the world, that of the California Gas & Electric Corporation, at Martin Station. Three engines have each been producing 3,200 kilowatts per hour for from ten to twenty-four hours per day since January, 1907, and have a full capacity of 4,000 kilowatts apiece. They have operated in parallel with all the power plants of the corporation, primarily furnishing current for the street railroads of San Francisco. One of these great engines standing cold and inert as a power potential, can be converted into a pulsating power producer in just one minute's time. When fuel economy is desired the gas engine's pre-eminence is assured.

But for universal use it is found that the electric motor is more convenient and flexible than even the gas engine, and this rapid age awards the palm to it. The factor of economy is introduced by water. For of the two fundamental power sources, fuel and water, the latter is the cheaper, and also the more lasting. So uniform has been the advance along the lines of hydro-electricity recently that it is hard to differentiate any one achievement as more notable than another, but we of the West are today marveling over the performance of a 9,700-horsepower Francis turbine at the Centerville plant of the Bay Counties Power Company. Never before has a Francis turbine been designed for so high a head as 550 feet.

But this essay is not intended as a discussion of the relative merits of these various methods of power development and transmission. The most enthusiastic engineer recognizes that no one of them should be applied to every time and place, that one must often supplement the other, and that all together they are aiming to make an integral whole, all necessary, all inter-related. Correct conclusions cannot be deduced where there is fear of a rival's success, hate of his personality and prejudice against his product. The deeds of the past are but incentives for the doers of the future, and in the year now before us we can predict even greater strides toward perfection, which we are approaching even as the hyperbola approaches its assymptotes. We can avoid unstable equilibrium only by progressive motion, and for that we have "that best and most precious of inspirations—the inspiration of things to do and of things undone—the inspiration of big jobs."

TRADE CATALOGUES.

The Dean Gas Engine and Foundry Co., of Newport, Kentucky, send an interesting catalog of the Dean engines, gas, gasoline, alcohol and distillate. This catalog gives the bow and stroke of the cylinders, and the capacity in cubic inches. Net prices are given.

In bulletin No. 4550, the General Electric Company, Schenectady, N. Y., describes several carbon break circuit breakers. Type C, form G circuit breakers are designed for a small, reliable, automatic, protective device for direct and alternating current systems, at a moderate price. Type C, form P, are particularly adapted for use on railway and power systems which are frequently subjected to severe short circuits and heavy overload. They are made up to 12,000-ampere capacity. Type C, form K, especially designed for heavy service, are particularly well suited for railway work. They are made in capacities up to 10,000 amperes. The bulletin also contains descriptions of auxiliary switches, automatic tripping devices, etc., to be used with the circuit breakers, and gives complete data as to capacities, prices and dimensions of the devices shown. The bulletin contains thirty-six pages and is conveniently arranged for reference.

Bulletin No. 4551, recently issued by the General Electric Company, illustrates and describes the various types of Thomson horizontal edgewise instruments, giving dimension sketches and a complete set of full-sized scales. The wattmeters, power-factor indicators and frequency indicators are constructed on the direct-reading dynamotor principle; the ammeters and voltmeters on the Thomson inclined coil principle. All the instruments are of uniform size, thus giving a pleasing appearance when installed. The horizontal edgewise design has been adopted for the majority of high-grade work since it was first introduced some years ago. While primarily designed for alternating-current service, the voltmeters, ammeters and wattmeters can be used with good results on direct current.

PERSONAL.

Mr. Wm. Hewitt, of the Hewitt Machinery Co., has returned to San Francisco after an extensive trip throughout the East.

H. W. Johnson, general manager of the Simikameen Power Company, has returned to Oroville, Wash., after an extended trip East.

C. M. Hobbs has retired as general manager of the Nevada-California Power Company, operating at Tonopah and Goldfield. Delos A. Campbell, the recently elected president, assumes the general management.

Walter M. Fagan is leaving San Francisco to take charge of the Los Angeles office of the Telephone & Electric Equipment Company. H. E. Bittman of Los Angeles has been transferred to the San Francisco office.

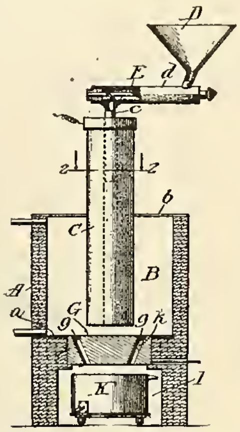
Carl H. Holley has resigned as general superintendent and chief engineer of the Mt. Whitney Power Co., and will open offices in Visalia, California, with H. H. Holley, as electrical and irrigation engineers.

The next monthly meeting of the American Society of Mechanical Engineers will be held Tuesday evening, January 14, in assembly room No. 1, of the Engineering Societies' Building, at 29 West Thirty-ninth Street, New York. The subject will be "Car Lighting," the presentation being made by Mr. R. M. Dixon, president of the Safety Car Heating and Lighting Company, and will treat of the general subject of light of trains, showing relative economies in the several systems, electric and gas. There will be in operation exhibits of different methods, such as the Pintsch mantle, the vapor mantle system, a new acetylene system, and several varieties of axle lighting by electricity, with their regulating and governing mechanism.

PATENTS

ELECTRIC SMELTING-FURNACE. 873,890. William R. Parks, Chicago, Ill., assignor to Samuel Shaw Parks, Chicago, Ill.

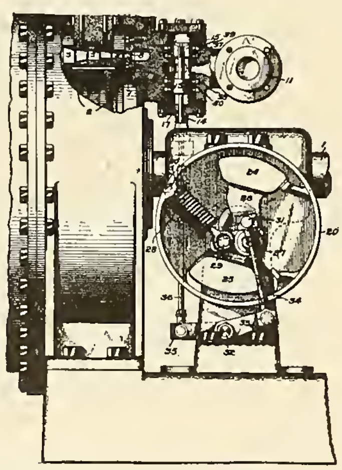
In an electric furnace, the combination with a tubular positive electrode, of a negative electrode having a circular



gutter in its upper surface concentric with the axis of positive electrode, and having a series of drains leading from said gutter, the lower openings of which converge toward the axis of negative electrode.

GOVERNING MECHANISM FOR TURBINES. 873,243. Oscar Junggren, Schenectady, N. Y., assignor to General Electric Company.

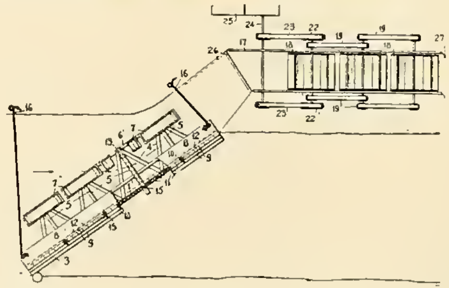
An elastic-fluid turbine having wheel buckets and independent fluid-admitting devices, in combination with a valve having a constant to-and-fro movement varying in amplitude with the load, that is common to the devices to regulate the passage of a motive fluid to the devices, and is interposed be-



tween them and the source of fluid supply, a governor responding to changes in load on the turbine, a member carried by and rotating with the governor weight whose orbit enlarges and diminishes as the load changes, and a connection which transforms the rotary motion of the member into a to-and-fro motion of the valve and also changes the amplitude of its movement with changes in size of the orbit of the member.

PORTABLE POWER-DAM. 873,845. William H. Crow, Pueblo, Colo.

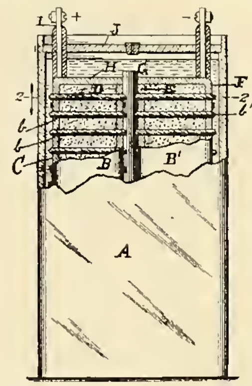
In a portable dam, longitudinally arranged timbers spaced



at a distance from each other, braces connected with timbers, floats at the forward end of braces, and vertically movable plank passed through the space between two timbers.

ELECTRICAL ACCUMULATOR. 873,715. Charles Busch, New York, N. Y.

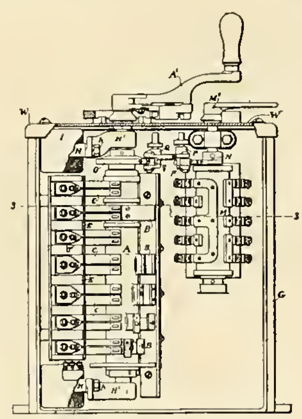
In an electrical accumulator, an element consisting of a metallic envelop formed of a sheet of substantially non-cor-



rosive metal folded so as to form a tube, active material contained within the tube and the ends of the envelop folded in so as to inclose the active material, perforations in the walls of the envelop and a capillary lacing passing through the perforations and uniting the opposite walls in the manner of a sinuous winding.

CONTROLLER. 873,805. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company, a corporation of New Jersey, and The Bullock Electrical Manufacturing Company, a corporation of Ohio.

In a controller, a controlling drum, a shaft of magnetic

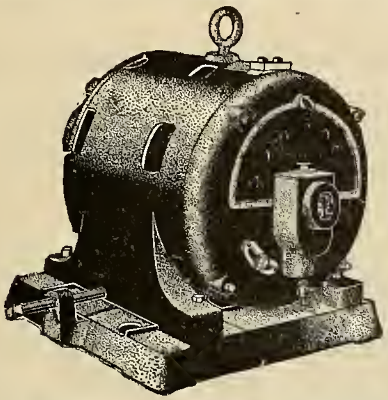


material therefor, a plurality of blowout magnets outside of the drum and having the controller shaft as part of the magnetic circuit, and plugs of magnetic material inserted in controlling drum adjacent to the circuit-breaking points of the controller.

INDUSTRIAL

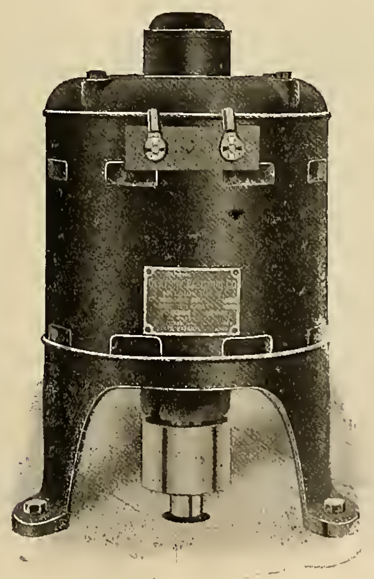
SINGLE PHASE MOTORS.

The recognition among central station engineers and managers of the many advantages and economies of the single phase motors up to certain sizes (see article "Journal," December 21st) has led to such an increased demand for a perfect operating, durable single phase motor that the Century Electric Co., of St. Louis, Mo., has not only been compelled to increase its factory three times in as many years, but the demand for sizes larger than five horsepower has caused Mr. E. S. Pillsbury, vice-president and engineer of the company, to develop a 7½ and 10 horsepower, which tests show to give the best performance in point of efficiency, starting torque, over-



load capacity, and high power factor of any single phase motor yet tested.

The Century Electric Company, through Mr. Pillsbury, has confined its entire efforts to the manufacture and perfection of single phase motors only, and has many fundamental patents, as well as patents on improvement of detail, which, embodied in the "Century" motor, really places them beyond comparison



with any competitor.

Inspection instantly reveals a sturdy frame, completely protecting the winding, yet sufficiently ventilated to keep the rise in temperature of the warmest part below 40 degrees C.

The distributed wound stator, the terminal board and posts for changing the motors for operation on either 104 or 208 volts, the large shaft and liberal bearings and oil receptacles are noteworthy points. These motors are purely induction motors, self-starting under 25 per cent overload without condenser, compensating transformer, phase coils, clutches, or clutch pulleys. There is no moving wire in the rotor that is in any way connected to the line current, which makes it possible to so insulate the windings as to minimize the danger of breakdowns.

These motors are adapted to the operation of any kind of machinery, not requiring extremely frequent stopping and starting, or speed variation through the motor. For operating of irrigating or house pumps and compressors, refrigerating machines arranged for automatic starting and stopping by pressure or float switches, their action is ideal, and no attention is necessary. They are constructed for mounting on floor, wall or ceiling, and are easily reversed in direction of rotation. A non-inductive starter for use in series with the motors is provided for limiting the starting current, and raising the power factor when conditions render it advisable.

The district sales agents, the Standard Electrical Works, at 117 to 121 New Montgomery Street, San Francisco, Cal., have a full line of these motors, ½ to 10 horsepower, inclusive, in stock for frequencies of 50 and 60 cycles standard speed; also the ½ horsepower variable speed for operating printing presses, etc., where speed control of 50 per cent or less is required. They report the demand constantly increasing, and perfect satisfaction from their many customers scattered over the entire Coast. Ask for Bulletin No. 9, and prices.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on January 15, 1908, to secure eligibles to fill vacancies in the position of electrical assistant in the Signal Service at Large, at $900 per annum each, with prospects of promotion to $1,400 per annum. The examination will consist of practical questions in electrical science and in construction and installation of electrical instruments. Applicants should be thoroughly familiar with the practical side of electricity as applied to telegraph, telephone, and cable engineering, and also with the methods of testing and installing electrical instruments used in fire control, such as storage batteries, motor generators, power and telephone switchboards, wireless telegraph apparatus, telegraphs, electric clocks, telephones, etc.

An examination will be held on January 22, 1908, to fill two vacancies in the position of assistant engineer of tests in the testing laboratory at Watertown Arsenal, Mass., at $1,200 per annum each. The examination will consist of applied mechanics, strength of materials, testing apparatus and methods, and experience in manipulation and test making (rated on application). Applicants should give in their applications a clear, complete, and detailed account of their experience in the manipulation of testing machines and in the making of tests, stating every detail in proper order of time and omitting nothing that may enable the examiner to form a correct estimate of the value of their experience. Only those who show in their applications that they have received a good theoretical or practical training in civil or mechanical engineering and who, in addition thereto, show in their applications that they have had practical experience in manipulation of material-testing machinery will be admitted to the examination.

On January 22, 1908, to fill a vacancy in the position of teacher of mechanical drawing (male or female), at $600 per annum, Carlisle School, Pa., and vacancies requiring similar qualifications as they may occur in the Indian Service, an examination will be held in arithmetic and computations (including decimals and simple mechanical computations), drawing and shading (including a finished mechanical drawing made from rough sketch and showing shade and section lines), drawings and specifications (including the making from sketch and description of a finished drawing for photolithographic reproduction).

FINANCIAL.

Porterville.—Assessment No. 8 of $10 per share has been levied on the Copo De Oro Water Company, delinquent January 1st.

Lemoore, Cal.—A special meeting of the stockholders of the Tres-Sierritas Oil & Mining Company will be held soon to consider diminishing the capital stock.

Vallejo.—The Board of Public Works has recommended to the City Trustees that immediate steps be taken to call a special election at which the people of Vallejo shall be given an opportunity to vote on the advisability of bonding the city for an additional $60,000 for a municipal water system.

Redwood City.—The mass meeting of Redwood City citizens for the consideration of a bond issue has been held. It was decided that $30,000 was needed, which should be divided as follows: $10,000 for a city hall, $15,000 for three steel water tanks, and $5,000 for water pipe.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Hunt, Mirk & Co.

Alternators
California Electrical Works
General Electric Co.

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
Electric Appliance Co.
California Electrical Works.
Century-Klein Electric Co.
Partrick, Carter & Wilkins Co.
Tel. and Elec. Equipment Co.

Asbestos Products
Johns-Manville Co., H. W.

Batteries, Primary
California Electrical Works
Standard Electrical Works

Batteries, Storage
Western Electric Co.
Century-Klein Electric Co.
Electric Storage Battery Co.
Tel. and Elec. Equipment Co.

Boilers
Moore, C. C. & Co., Inc.
Standard Electrical Works
Tracy Engineering Co.
Hunt, Mirk & Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
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Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
General Electric Co.
Northern Electrical Mfg. Co.
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Electric Heating Devices
Electric Appliance Co.
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Electrical Instruments
Electric Appliance Co.
Cutter Co., The
Century-Klein Electric Co.
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Electric Watchman's Clocks
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Engineers, Chemical
Smith, Emery & Co.
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Standard Electrical Works
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Hunt, Mirk & Co.
Century-Klein Co.
Copeland, Clem A.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. B.
Smith, Emery & Co.

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XX. SAN FRANCISCO, CAL., JANUARY 11, 1908 No. 2

HIGH POWER HARBOR CRANES.

One of the most useful of all modern hoisting equipments for harbor use is the floating crane, as it may easily be moved to any point desired and is quickly in position to move the heaviest loads with safety and economy. For repairs the great floating and other cranes can handle yachts or launches without difficulty. Steam power is almost universally employed for this service, as current cannot readily be obtained on the floating crane from power plants on shore without considerable expense for cables, and the difficulties in handling same, which would be prohibitive.

FLOATING CRANE AT IMPERIAL DOCKYARD AT KIEL, GERMANY.

The accompanying illustration shows a floating crane of 100 tons' lifting capacity in service at the Imperial Dockyard at Kiel, Germany, a similar floating crane also being used at the Wilhelmshaven Imperial Dockyard. It can be moved by its own power at a speed of 3 to 4 knots per hour, and is provided with two sets of tackle for 8 tons and for 30 tons. The pontoon supporting this crane is nearly 151 feet long and about 60 feet wide, with a height of a trifle less than 10 feet, and the highest position of the hook above the sea level is 98 feet 5 inches for one set of hoisting tackle, and 121 feet 5 inches for the lighter set of tackle.

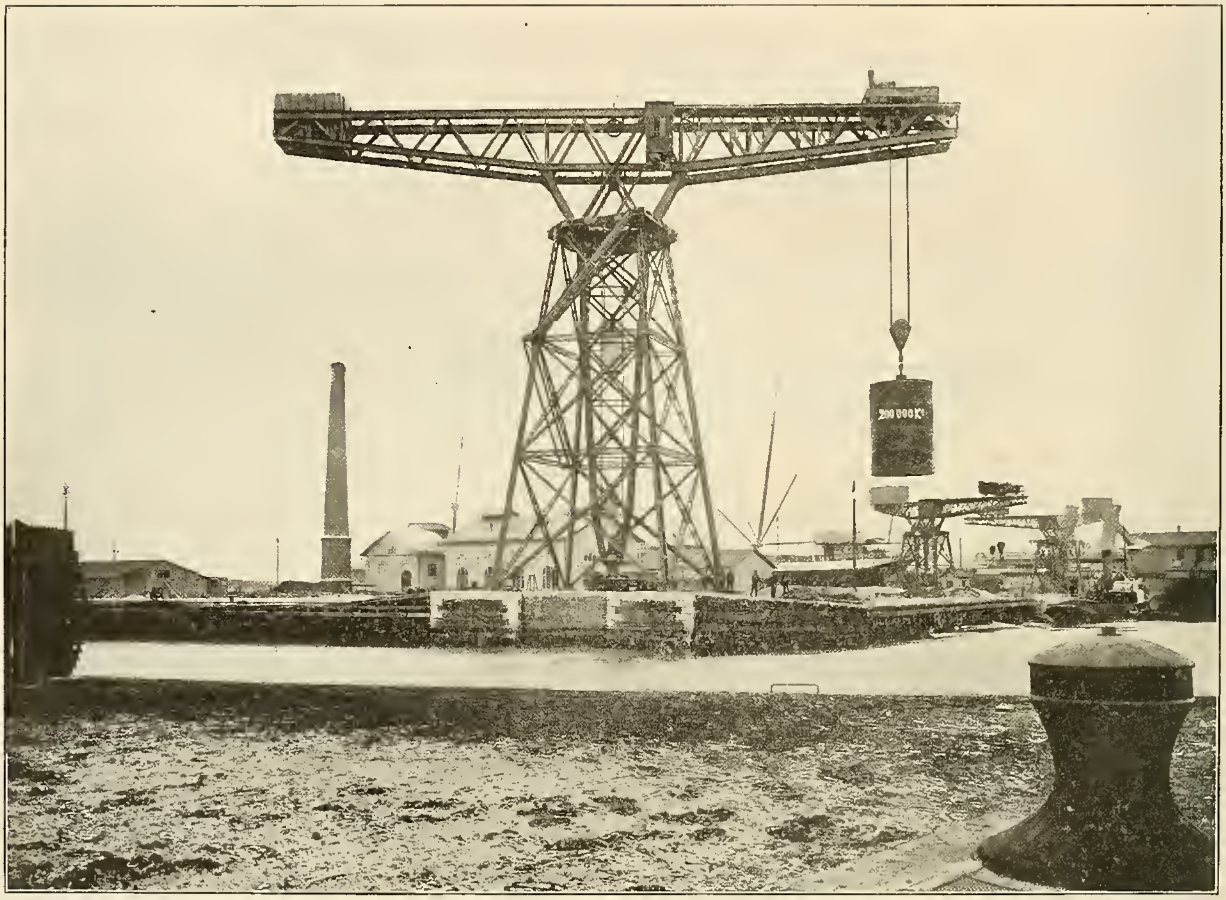
It is stated that the time taken to lift 100 tons to a height of about 100 feet by this floating crane is 30 minutes, and the radius of action outwards from the front edge of the

pontoon is about 36 feet and inwards about 20 feet, with a load of 200,000 pounds.

There are similar cranes of 150 tons' capacity in operation in the harbors at Glasgow and Hoboken, as well as Vegesack, also in China at the harbor of Tsingtau. The latter was installed by the Duisburger Maschinenbau-Actien Gesellschaft, formerly Bechem & Keetman, and the former by the Benrather Maschinenfabrik.

The accompanying illustration shows the construction of the great electric rotary cranes at Bremerhaven, Germany, having a lifting capacity of 150 tons and 50 tons, the two plants in the shipyards, far from electric central stations supplying current for commercial light and power service in the cities so equipped. The great rotary crane noted in the accompanying photograph located at the "Howaldtswerke," at Kiel, has a capacity of 150 tons, the radius of action with this maximum load being 65 feet 7½ inches, while the lighter hook and hoisting mechanism is capable of lifting 50 tons, with a maximum radius of action of 134 feet 6 inches, the smallest radius being 26¼ feet.

The total height of this electric rotary crane is 154¼ feet, while the height of the trestle is a trifle over 119 feet.



ELECTRIC ROTARY CRANE AT BREMERHAVEN.

in the background being noted without load, and the crane in the foreground having a maximum load of 200,000 kilograms suspended at its full radius of action. The smaller cranes each have a capacity of 100,000 pounds, with a total height of 38 feet 9 inches and radius of action of 39 feet 4½ inches, while the height of the bridge is 26¼ feet.

The largest crane shown in the foreground, carrying a test load of 200 tons, is 114 feet 10 inches high and is capable of covering an area of 1,819 square feet with the trestle, which is 85 feet 11½ inches from the ground. It has a total radius of action of 72 feet 2 inches.

Some of the largest stationary harbor cranes of the great European countries are operated electrically from power The electric motors are mounted on the trolley, tower and bridge of the crane, and the controlling mechanism is installed in the cabing on the top of the crane.

The structural steel work of this crane was made at the Gutehoffnungshutte, at Oberhausen, for the Benrather Maschinenfabrik. It is maintained that where electric current can be obtained at reasonable rates from a central power station or be supplied from an electric plant also used for lighting service and motor service in the shipyard or harbor, the electric propulsion of portal, semiportal and other dock cranes, as well as tower, jib and traveling cranes, is not only most economical, but most satisfactory in operation, being easily controlled with the least amount of labor and maintenance.

ENERGY TRANSFORMATIONS FROM THE ELECTRICAL ENGINEERS' STANDPOINT.*

By H. M. Hobart.

(Continued.)

When, however, we wish to convert heat into electricity, or into work, high efficiencies are not attainable. There are no known means of transforming heat directly into electricity on a large commercial scale. Heat may, with a low efficiency, be transformed into work in a steam engine or a gas engine, and the work may, at high efficiency, be transformed into electrical energy. The large portion which, in the first step, is not transformed into work, remains heat; the small part which, in the second step, is not transformed into electricity, is converted into (or lost as) heat. Of the heat absorbed by a large steam engine or steam turbine, during the passage of the steam, only some sixty per cent can, in the present state of the art, ultimately be converted into electricity.

When we trace the process back to the calorific contents of the fuel, it may be stated that only about 7.5 per cent can be converted into electricity. With gas engines, some twenty-five per cent of the calorific value of the fuel may be transformed into electricity in the circuits supplied from the dynamo driven by the engine. The greater efficiency of the gas engine is, however, in large units, offset by the greater cost, greater depreciation and greater space required, as also, in many cases, by the disadvantage associated with its less uniform turning moment and its less reliability at the present stage of its development.

Let us therefore direct our attention to the steam engine or steam turbine, which, as already stated, permits, in large sets, of converting into electrical energy some sixty per cent of the energy abstracted from the steam in its passage through the engine.

In accordance with this definition of the efficiency of an engine, the heat rejected to the condenser is not regarded as a loss.

It may be, for instance, and often is, employed in heating

TABLE VIII.

Table of the Energy in Kilowatt-hours Required to Convert One Ton of Water at Zero Degrees Centigrade into Steam at Various Temperatures and Pressures.

Absolute Pressure in Kg. per Sq. Cm.	Temperature of Vaporization in Deg. Cent.	Steam Heat of Saturated Steam in Kw.-Hr. per Ton.	Steam Heat (in Kilowatt-Hours per Ton) of Steam Superheated to Following Final Temperatures in Deg. Cent.							
			100 Deg.	150 Deg.	200 Deg.	250 Deg.	300 Deg.	350 Deg.	400 Deg.	450 Deg.
A	B	C	D	E	F	G	H	K	L	M
0.02	17	700	747	775	803	831	859	885	913	940
0.04	29	704	747	775	803	831	859	885	913	940
0.06	36	709	747	775	803	831	859	885	913	940
0.08	41	713	747	775	803	831	859	885	913	940
0.10	46	716	746	774	802	830	858	884	912	940
0.12	49	717	746	774	802	830	858	884	912	940
0.15	54	720	746	774	802	830	858	884	912	940
0.20	60	724	746	773	802	830	858	884	912	940
0.25	65	725	745	773	801	824	858	884	912	940
0.30	69	727	745	773	801	824	858	884	912	940
0.35	72	729	745	773	801	824	858	884	912	940
0.40	76	730	745	773	801	824	858	884	912	940
0.50	81	733	744	772	800	828	857	883	911	939
0.60	86	736	744	772	800	828	857	883	911	939
0.70	90	737	744	772	800	828	856	883	911	939
0.80	93	739	744	771	800	827	856	883	911	939
0.90	96	740	744	771	800	827	856	883	911	939
1.0	99	741	742	770	799	826	855	882	911	938
1.1	102	743		770	799	826	855	882	911	938
1.2	104	745		770	799	826	855	882	911	938
1.4	109	746		770	799	826	855	882	911	938
1.6	113	748		770	799	826	855	882	911	938
1.8	116	750		770	799	826	855	882	911	938
2.0	120	752		769	798	826	854	882	911	938
2.5	127	754		768	797	826	854	881	911	938
3.0	133	756		767	796	825	853	881	911	938
3.5	138	758		766	795	825	853	880	911	938
4.0	143	759		764	794	824	852	879	910	938
4.5	147	761			794	824	852	879	910	938
5.0	151	764			794	824	852	879	910	938
5.5	155	766			794	824	852	879	910	938
6.0	158	767			793	823	852	879	910	938
6.5	161	767			792	822	852	879	909	938
7.0	164	768	Wet steam.	Wet steam.	791	822	851	879	909	938
7.5	167	769			790	821	851	879	909	938
8.0	170	770			789	820	850	879	908	937
8.5	172	771			789	820	850	879	908	937
9.0	174	771			798	820	850	879	908	937
9.5	177	772			798	820	850	879	908	937
10.0	179	773			787	819	849	878	908	936
11.0	183	775			786	819	849	878	908	936
12.0	187	776			785	818	848	878	907	936
13.0	191	777			784	817	848	878	907	936
14.0	194	778			782	816	847	877	907	936
15.0	197	778			781	815	846	877	906	936
16.0	200	779			779	813	845	876	905	935
18.0	206	780			779	812	844	876	905	935
20.0	211	781			779	811	843	815	905	935

processes. Waste-heat engines have also been devised for employing the lower temperature ranges. Whether or not it be expedient further to employ the heat energy rejected to the condenser, it is nevertheless heat energy. Subtracting this energy from that contained in the steam at admission, we have as the remainder the energy which has undergone transformations in the steam engine or turbine. A large portion of fuel cost per "kapp" delivered at the outgoing cables is some forty cents. The remaining running costs would raise this to a total of some sixty cents for the total operating costs. If, with fifty-per cent load-factor, 200 million "kapps" are delivered annually from the generating station, the capital cost for a station designed on modern lines works out at some $15,000 per million "kapps" per annum. On the basis of

TABLE IX.

Wetness Factors at Exhaust for Steam Expanded Adiabatically from Various Initial Temperatures and Pressures.

Exhaust Pressure in Kg. per Sq. Cm.	Admission Pressure in Kg. per Sq. Cm. 16			14				12				10				8				6			
	Admission Temperature in Degrees Centigrade. 200	250	300	174	200	250	300	187	200	250	300	179	200	250	300	170	200	250	300	158	200	250	300
0.05	**0.24**	0.21	0.19	**0.23**	0.23	0.21	0.18	**0.23**	0.22	0.20	0.17	**0.22**	0.20	0.18	0.16	**0.22**	0.20	0.18	0.15	**0.20**	0.18	0.15	0.13
0.1	**0.23**	0.20	0.17	**0.22**	0.22	0.19	0.16	**0.22**	0.21	0.18	0.15	**0.21**	0.19	0.16	0.14	**0.20**	0.18	0.14	0.13	**0.18**	0.16	0.13	0.10
0.2	**0.21**	0.17	0.14	**0.19**	0.19	0.16	0.13	**0.19**	0.18	0.15	0.12	**0.18**	0.17	0.14	0.11	**0.17**	0.15	0.12	0.09	**0.16**	0.13	0.10	0.07
0.4	**0.18**	0.14	0.11	**0.16**	0.16	0.13	0.10	**0.16**	0.15	0.12	0.09	**0.15**	0.14	0.10	0.08	**0.14**	0.12	0.09	0.06	**0.12**	0.10	0.07	0.04
0.6	**0.17**	0.13	0.09	**0.15**	0.15	0.11	0.38	**0.15**	0.13	0.10	0.07	**0.14**	0.12	0.09	0.06	**0.13**	0.11	0.08	0.04	**0.11**	0.09	0.05	0.01
0.8	**0.16**	0.12	0.08	**0.13**	0.13	0.10	0.07	**0.14**	0.12	0.09	0.06	**0.13**	0.11	0.08	0.04	**0.11**	0.09	0.06	0.03	**0.10**	0.07	0.04	....
1.0	**0.14**	0.10	0.07	**0.12**	0.12	0.09	0.06	**0.12**	0.11	0.08	0.04	**0.12**	0.10	0.07	0.03	**0.10**	0.08	0.04	0.05	**0.09**	0.06	0.02	....
1.5	**0.11**	0.08	0.05	**0.11**	0.11	0.07	0.04	**0.10**	0.09	0.06	0.03	**0.09**	0.08	0.04	0.01	**0.08**	0.06	0.03	....	**0.07**	0.04	....	....

Wetness Factors.

Note.—The values for steam initially saturated are set in h Wetness Factors.

this has been converted from heat energy into useful work energy, and the remainder is ultimately wasted in heating the engine and the surroundings.

The ratio of the energy delivered from the engine as work, to the energy which has been absorbed in the engine, is designated the "thermodynamic" efficiency. In Table VI are set out the amounts of "convertible" energy per ton of steam when working between various admission pressures and temperatures and various exhaust pressures. With an engine of sixty per cent "thermodynamic" efficiency the work energy obtained per ton of steam is equal to 0.60 of the "convertible" energy set forth in the table.

The values obtained in the table are determined on the assumption of expansion without loss or gain of energy by the steam. Its temperature during this process of so-called "adiabatic" expansion decreases in accordance with definite thermodynamic laws into which it is not proposed to enter. Accompanying the decrease in temperature there is, for certain ranges, a condensation of a portion of the steam. The corresponding "wetness factors" are set forth in Table IX.

It is the writer's experience that by means of the system and tables above set forth the general problems associated with electricity supply and distribution may be solved more effectively than is otherwise possible. Calculations which, by older methods and mixed units, have been tedious and involved, may be readily carried out and the significance of each stage of the calculations becomes much more evident.

Since, however, the designation "kilowatt-hour" is illogical and obscure, it is highly desirable that it be replaced by some suitable name. It has been suggested (editorial in the London Times Engineering Supplement for August 7th, 1907), that this quantity might be termed a "kelvin" or a "kapp." The latter term would be ideal from the standpoint of brevity. The energy in one ton of good coal is some eight to nine "kilokapps." At a price of $3.50 per ton, this works out at some forty-four cents to thirty-nine cents per "kilokapp." If the annual over-all efficiency of an electricity supply station is, in some particular case, ten per cent, then the seventeen per cent for interest and depreciation, this constitutes an annual charge of twenty-six cents, thus bringing the total cost per unit up to about eighty-six cents per "kapp" delivered from the generating station. By similar calculations for the cost of cables, sub-stations and low-tension network and for the cost of the energy wasted in these components of the system, the cost delivered to the consumer may be estimated.

If the proposal to substitute the short word "kapp" for the kilowatt-hour does not find acceptance, the above ready means of following through such calculations are not invalidated and it is merely required to substitute in the text the usual term kilowatt-hour.

CIVIL SERVICE EXAMINATIONS.

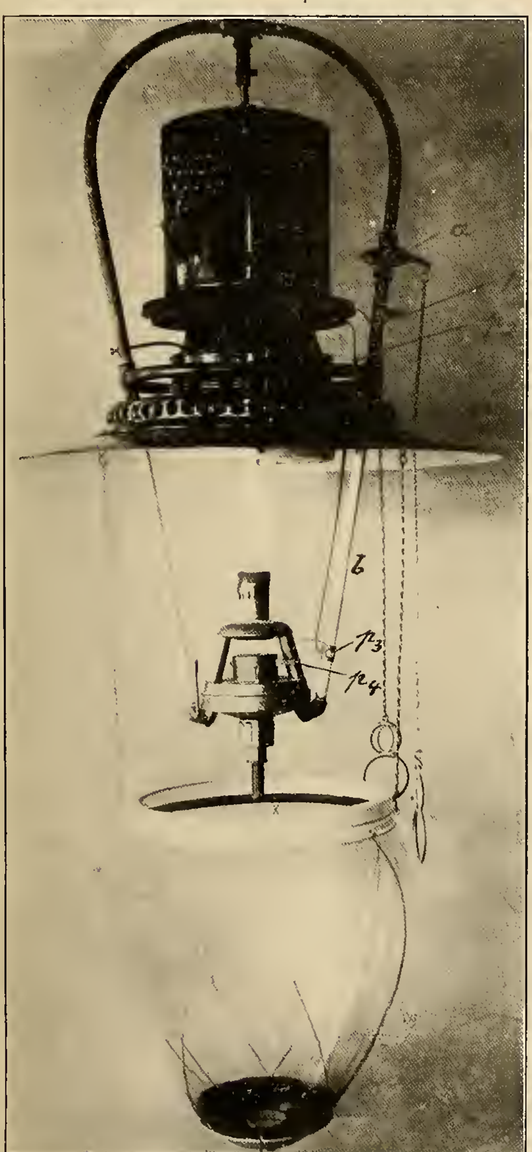
The United States Civil Service Commission announces an examination on January 29-30, 1908, to secure eligibles to fill a vacancy in the position of topographic draftsman, $900 per annum, in the Coast and Geodetic Survey, and vacancies requiring similar qualifications as they may occur in any branch of the service. The salary for the position of topographic draftsman ranges usually from $1,000 to $1,500 per annum, and for copyist topographic draftsman from $900 to $1,500 per annum.

An examination will be held January 29-30, 1908, to secure eligibles from which to make certification to fill at least three vacancies in the position of miscellaneous computer, Naval Observatory, Washington, D. C., and vacancies requiring similar qualifications as they may occur in that observatory. The Department states that miscellaneous computers are paid by the hour and earn from $1,000 to $1,200 per annum. Promotions are made from this grade, without further examination, to the grade of assistant, at $1,200 per annum, as vacancies occur. The examination will consist of the subjects mentioned below: Pure mathematics, including geometry (plane and solid), algebra, trigonometry (plane and spherical), and calculus, all as covered in the higher-class text-books; astronomy (elementary questions in spherical and general astronomy); practical computations, involving mathematical and astronomical knowledge as indicated under the subjects of pure mathematics and spherical astronomy, but especially designed to test the competitor's ability to use tables of logarithms quickly and correctly; training and experience (rated with special reference to the class of work involved).

A NEW GAS LAMP.

By Hugo Brunnsburger.

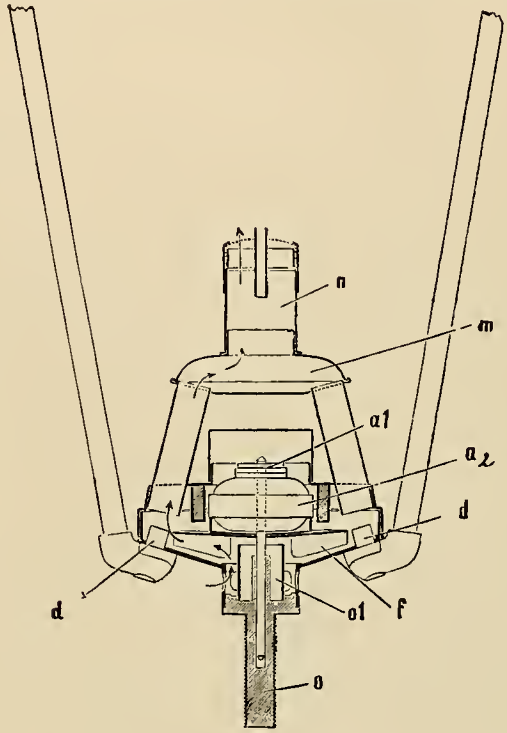
Various means for increasing the supply of air to incandescent gas lamps have been recently devised. Welsbach employed an injector effect, and Lucas a long chimney. Other systems, invented under the name of compressed gas, are based on an artificial supply of compressed air. One way



proposed is to leave the producing plant and pipe lines unchanged, but to employ small fans to suck large quantities of air. The power to rotate these fans is taken from the heat of the lamp. Lucas has recently solved the problem in a simply ingenious way.

The new invention uses thermal electricity, developed by copper, nickel and aluminum, to propel a small electromotor with fan.

The gas goes through the cock **a** and the pipe **b** into the casing of the electromotor, through this into the top of the burner and mantle. Above the latter, within the chimney, is the thermo-element **c**. Here the electric energy is generated by the heat of burned gases and is conducted through the poles p_1 and p_2 to the poles below p_3 and p_4; from these it enters the motor. Two small silver brushes rest upon the collector of the armature. The latter is mounted on a vertical shaft which runs in a box-bearing entirely in oil. Coupled to the armature, a_2, is the small fan with its wings, f, so that during rotation the wings draw air through the openings o_1 and push along a curved way up to the



mantle, as shown by the arrows. Thus the atmosphere mixes with the escaping gas and proceeds under increased pressure to the mantle, there producing a theoretically complete combustion. At **o**, a bushing is arranged, which can be screwed up and down in order to regulate the incoming air by enlarging or diminishing the air holes. The only rotating part is the small electromotor and fan, which both form one piece, running with a speed of 2,000 revolutions per minute. The thermo-element is made from alloys which stand a temperature of 1,200 degrees, but these are subjected in this lamp only to about 600 degrees, so that the element will have a long life.

The new lamp is of small size and can be built for pipes hanging from the ceiling or as a wall-candelabra or be placed upon a vertical post, for exterior as well as interior. It is rain and storm proof and can be ignited by pulling a chain. It is claimed that the lamp is remarkably efficient.

MEETING NOTICE.

The next meeting of the New York Section of the Illuminating Engineering Society will be held at 8:15, Thursday evening, January 9th, 1908, in the United Engineering Societies Building, 33 West Thirty-ninth Street. Dr. H. H. Seabrook will present a paper entitled "Light and the Eye."

THE HEATING OF ENCLOSED MOTORS.

By A. G. Wessling.

In the design of electric motors, whether to be driven by alternating or direct current, the question of heating is of utmost importance, because the temperature at which the machine operates directly affects the length of its life. Since most insulating materials become charred at temperatures of 100 degrees centigrade or over, this limit should not be exceeded, and the lower the temperature can be kept the longer will be the motor's usefulness. Great progress has been made in the matter of ventilating all types of electrical machines.

At present many machines include in their construction regular fan blades attached to the revolving element, which produce a forced draft through numerous air ducts in the stationary element. Of course attention is given to reducing the losses whereby the heat is produced, to a minimum. It is not economical, however, to carry this reduction beyond a certain limit, which for ordinary machines may be roughly taken as being 10% of their rated capacity. The dissipation of heat is more rapid with increase in speed in open types. For a given rise in resistance the number of watts which may be dissipated per square inch is almost directly in proportion to the speed. It is evident, therefore, that by doubling the speed of a given machine its output may be doubled with practically the same rise in temperature.

In the case of motors which are tightly enclosed, the heat generated cannot be so readily disposed of, as all of it must be transmitted to the outer shell and thence radiated. As the rate at which heat is radiated from a given metallic shell depends only upon the difference in temperature between the shell and the surrounding air, it is evident that for a given rise in temperature the total number of watts which can be radiated from a given frame is fixed. Since the losses in a motor may be taken as ten per cent of its rated capacity, it would seem that a given frame could be used for but one rating with a given rise in temperature. If the motor were a solid mass of metal in which the heat were generated uniformly, and if the temperature of the outside surface were the measure, this would be true, but in the actual machine most of the heat is generated in the armature and must be transmitted through a long air space to the outer shell. The rate of transmission from armature to shell is affected by the distance between the two and by the peripheral speed of the revolving element. The capacity of the motor can therefore be increased as the speed is increased, but not in the same ratio.

In hot places there is great danger that the motor temperature will exceed the 100-degree limit. To simply operate the motor at light load is not sufficient to guard against overheating, because the losses which vary with the load are but a fraction of the total losses, and a motor which does not exceed 65 degrees rise when loaded may exceed 55 degrees when running idle.

It is evident, therefore, that an installation of enclosed motors will be much more expensive than if open motors are used. For the motors must be approximately one-third larger, which will increase the cost by about the same amount. Being special in construction, the price will be still higher for that reason. And because the operating temperature will be so much higher, the charge for depreciation should be at least doubled. In view of these facts, the enclosed type of motor should only be used when absolutely necessary.—The Sibley Journal of Engineering.

COPPER MARKET SITUATION.

Manufacturers of wire and copper goods operate cautiously, but they are looking forward to a gradual improvement some time in the future. The return to normal conditions, however, will be slow, as there must be a more complete restoration of confidence before new enterprise will be embarked upon with earnestness. No one can doubt but that there will be an entire clearing up of the situation eventually, and this is the cheering feature we are all anxiously looking forward to, but our patience may be put to a few more tests while we are waiting for the elimination of the weak spots.

The local copper market remains dull, and domestic buying is for limited quantities. Consumers continue to buy from hand to mouth, and while this policy prevails it is hard to see how values can be advanced to a level not justified by trade conditions. Electrolytic Wire Bars are quoted at 13½ cents, with recent sales reported in both the domestic and foreign markets from 13 @ 13½. Some special business was said to have been on a higher basis.

The curtailment of copper production at some of the principal mines in the West and in Mexico is considered a wise measure, and this action should go far in preventing further market demoralization. The restriction in output is radical enough to allay the fear of another serious accumulation of stocks such as occurred in the third quarter of the year. If demand gradually improves, consumption ought to prove about equal to the reduced product now available.

Stocks of raw material in the hands of manufacturers are light, and under the influence of a conservative conduct of their business supplies will probably be kept very close to the limit of actual requirements for some time to come. This policy will keep matters on a healthier basis, and when the present financial and commercial disturbances are past, manufacturing plants will be better prepared to move ahead on a more extensive scale.

It is not to be supposed that conditions will suddenly improve for the better. It will take time for business to find solid footing to rest on again, and there is likely to be more commercial and industrial retrenchment before complete recovery sets in. But the slowing down process has started the cure, and the disease of over-expansion must be thoroughly checked before business reaches a safe and normal plane. Credits were stretched to the utmost danger point, and people were rushing on without attaching sufficient importance to the financial reckoning day that was sure to follow. Unconservative business and banking methods have brought forth their legitimate fruit, and we must be exceedingly careful as a nation not to repeat the same errors of judgment and practice in the future.

Present market prices for copper would no doubt prove satisfactory enough to manufacturers were demand at all encouraging, but with the small volume of current orders buying is not of a stimulating character. When the consumer has the trade he will pay any reasonable price for copper without objection. But what he wants to see is a condition of market stability that will not leave him in a position where he will be made to suffer as the victim to the caprice of mere manipulators. Fluctuations of 12 cents a pound in the price of copper inside of a few months is too violent for the healthy conduct of any business.—Copper Gossip.

60TH CONGRESS, 1ST SESSION.

S. 2661.

IN THE SENATE OF THE UNITED STATES.

DECEMBER 17, 1907.

Mr. CRANE introduced the following bill; which was read twice and referred to the Committee on Public Lands.

A BILL

Granting locations and rights of way for electric and other power purposes through the public lands and reservations of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the right to locate upon, and the right of way through, the public lands and reservations of the United States, excepting lands reserved for military or naval purposes, national parks, or national cemeteries, is hereby granted to any citizen or citizens of the United States, or corporations organized under the laws of any State or Territory which shall have filed with the Secretary of the Interior a copy of its articles of incorporation and due proofs of its organization under the same, their successors or assigns, for the construction, maintenance, and operation of electric and all other water-power plants and appurtenant structures, including canals, tunnels, flumes, pipe lines, or other water conduits, dams, reservoirs, and pole lines, to the extent of the ground covered thereby and fifty feet on each side thereof, together with fifty feet from the marginal limits of such buildings, structures, dams, and reservoir sites, together with the right to cut adjacent timber, subject to the conditions hereinafter expressed, where such timber would endanger such line or works, and to submerge and flood such areas as are shown and described upon the maps filed, as herein provided, and as may be necessary to impound the water in such reservoirs; also the right to take from the public lands adjacent to such works, materials, earth, and stone necessary for the construction and maintenance thereof: Provided, That the rights herein granted shall not be construed to interfere with the control of water for irrigation and other purposes under authority of the respective States or Territories.

Sec. 2. That any such person, association, or corporation desirous of securing the benefits of this Act shall file with the register of the local office for the district where such land is situated a map, in duplicate, showing the location and area required for the purposes herein provided, which shall thereupon be noted upon the plats in said office. And if the application be in accordance with the terms of this Act such map shall be approved by the Secretary of the Interior. From and after the filing of said map as aforesaid, lands over which said rights of way shall pass shall be disposed of only subject to such rights of way: Provided, That the lands covered by any structure or reservoir, or the site therefor, shall not be disposed of except to such grantee, his successors or assigns, unless forfeited as in this Act provided, and the same may be purchased by the grantee, his successors or assigns, after completion of such structures or reservoir, or any completed portion thereof upon the completion of such portion, at the price of two dollars and fifty cents per acre, and upon survey thereof patent shall issue therefor: Provided, also, That the right to the continued use and enjoyment of all the property, privileges, and rights of way hereby granted shall remain and continue in such grantee, his successors or assigns, from and after the date of the filing of said map or maps as above provided, and shall vest upon the completion of the same, or as to any such part shall vest upon completion of any part or portion thereof, as of the date of the filing of such map. But unless said grantee, successors, or assigns shall, within sixty days after the filing of such map, except where prevented by the elements, order of court, or other like cause, commence and continuously and in good faith prosecute to completion the works or structures for the diversion and use of such water and power, then and forthwith upon failure so to do all rights as to any uncompleted portion of said work or works and the sites and rights of way covered or claimed shall be forfeited without further action by the Interior Department, unless for cause shown the Secretary of the Interior shall extend the time, but said grantee, his successors or assigns, may within two years thereafter remove all structures and property from such uncompleted portion of such sites or rights of way: Provided, That work done upon and in connection with necessary surveys, and upon roads and trails preliminary and necessary to the proper performance of the work called for upon and in connection with such works and structures, shall be deemed work done upon and in connection with said work and structures as required in this section.

Sec. 3. That the grantee of any such right of way under this Act shall pay to the United States the full market value of all timber and wood cut, used, or destroyed within or adjacent to the right of way in constructing and maintaining its works, including damages for injuries to the adjacent lands of the United States caused by the digging of any canal or ditch, the laying of any pipe lines, or the construction of any power houses or other buildings appurtenant to the use and operation of the power plant and the flooding of the necessary area for the reservoir or reservoirs, such values and the extent of such damages to be ascertained by or under the direction of the Secretary of the Interior, and if after sixty days' written notice of such ascertained value or damage the grantee, successors, or assigns shall not pay the same, it shall be the duty of the Secretary of the Interior to cause to be instituted an action against said grantee, successors, or assigns in the proper court of the United States within the circuit or district within which said works or some part thereof are situated, for the recovery of such amount or amounts; and in any action so brought the finding and award of the Secretary of the Interior as to such value and damage shall be prima facie evidence of the amount thereof, but the court shall receive and consider all such other evidence as may be offered by the Government, or by the grantee, his successors or assigns, in order to correctly determine the amount of such value or damage, and the same procedure shall be had and taken in such suit or action as provided in law for suits or actions of like character in said court; and the grantee, successors, or assigns shall be liable for the amount required to be paid and for all costs in such suit or action as settled and allowed by the court. And such grantee, successors, or assigns shall be liable to any settler, occupant, or other person beneficially interested whose possession, right, or improvements may be taken or injured by the construction of the works or any of them herein authorized. The grantee hereunder, successors, or assigns, may, in the discretion of the Secretary of the Interior, be required to pay for the use of all or any of the rights and privileges hereby granted prior to patent thereof, not exceeding the following amounts per annum, to wit: For areas and sites for buildings and other structures, including reservoir sites, per acre or fraction thereof, one dollar; for rights of way provided for by section one of this Act, per mile or fraction thereof, one dollar, and shall, before the approval of such map, file with the Secretary of the Interior a bond, in a reasonable amount to be fixed by said officer, conditioned for the faithful observance of each and all of the conditions of this section.

Sec. 4. That any of the persons or corporations referred to in section one of this Act may construct and maintain all necessary roads and trails over any of the lands referred to in section one of this Act for use in connection with the construction and operation of the works and appurtenances herein provided for, with like privileges in connection with the use of materials, earth, and stone for the construction and maintenance thereof; and such roads and trails, when constructed, shall be subject to the free use of the grantee, successors, or assigns, and also to the officers and agents of the Government of the United States and all persons who may desire to use the same. All lands over which said roads or trails pass shall be subject to the right of way therefor, and if disposed of shall be disposed of subject thereto.

Sec. 5. That any existing right of way, license, permit, or privilege for any of the purposes provided for in section one of this Act shall, provided application therefor be made by the grantee or grantees, their successors or assigns, and only in that event, be approved by the Secretary of the Interior under this Act, either by the reapproval of the maps heretofore filed or the filing of new maps, at the option of the applicant, and shall, upon the filing of such new maps or the approval of the maps heretofore filed, be subject to all of the obligations and benefits of this Act.

Sec. 6. That Congress shall have the power at any time to alter, amend, or repeal this Act.

The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers Architects and Builders News

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
SUCCESSORS TO
The Journal of Electricity Publishing Company
111 New Montgomery St., San Francisco

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1896.

VOL. XX JANUARY 11, 1908 No. 2

EDITORIAL.

Hydro-Electric Plants in Forest Reserves.

We take pleasure in printing on another page a copy of the Senate Bill Number 2661, which was recently introduced in the United States Senate by Senator Crane, of Massachusetts, a companion bill being introduced in the House. This proposed law is intended to do away with the uncertainty that now exists as to the charge to be made for the manifold requirements of power plants in forest reserves. At present the land occupied by them is not in fee simple, as all permits to occupy these lands may be recalled at the discretion of the Forester. It is of the greatest importance to investors in these enterprises that companies complying with their permit conditions should have irrevocable rights of way and of occupancy for a definite time, long enough to insure stability of investment. The existing law is ambiguous in making no authorization of a charge for right of way over the unreserved public lands, and tends to discourage the development of the water power resources of the West. These facts are evident to all, being well recognized by the Government authorities.

"The Forest Service would welcome legislation on this subject providing for permits somewhat as follows:

"1. A definite term of years, the maximum to be fixed by statute.

"2. A reasonable charge, the maximum to be fixed in each permit when it is issued.

"3. At the expiration of any permit, the old permittee to be preferred, other things being equal, in granting the new permit. If the new permit goes to another he should pay to the old permittee the value of the improvements as appraised by the officers of the Department.

"4. The rate of charge to be reduced where a part of the right of way is on private land, or where an increase of the average annual flow of streams results from storage of water by the permittee."

The new bill as introduced grants locations and rights of way for electric and other power purposes through the public lands and reservations of the United States to citizens and corporations complying with the usual conditions in the purchase of the public lands. A map of the required land having been filed and approved by the Secretary of the Interior, permission is granted to build reservoirs and power plants, and when these are completed the land may be sold for $2.50 per acre, obtaining patent therefor. All damage to timber or land because of their work is to be paid for by the company.

This bill differs from the ideas of the Forest Service chiefly in the manner of compensation to the United States Government for privileges granted. It proposes a flat amount per acre of ground taken and a flat rate per mile of right of way required, instead of basing the charge upon the gross kilowatt output of the electric plants. It is about this point that the discussion centers.

In its view on this question the Journal has not been partisan, nor will it be. For years it has enjoyed the privilege of close co-operation with the officials of the Forest Service, and its columns have always been open for discussion. As has been repeatedly stated, there is no more noteworthy example of the beneficent activity of Government supervision than is exhibited in the intelligent conduct of the Forest Service. The important work that it is accomplishing should be encouraged in every way possible. That the Department is not attempting to increase monetary support by unfair taxation is shown by the high standard that has been attained in previous rulings. Supposing for the sake of argument that they should charge all power companies operating in forest reserves at the rate of twenty cents per thousand kilowatt hours, or make an annual fixed charge of seventy-five cents per theoretical horsepower in the water used, it will be seen that the tax on power delivered will often be twice that actually intended. For the losses in transmission are so high and the possibilities of accident between generator and motor are so many that the power actually used is much less than the dynamo output. The cost of the distributing lines and equipment is one of the greatest connected with a power installation, and if this tax were carried to its extreme conclusion the manufacturer of dynamos and even producers of iron and copper would be called upon to bear their just proportion. In equity it would be far better to charge a fair annual rental with the privilege to pur-

chase provided that the reservation is opened during the time of the lease.

By selling title outright, the Government is relieved of all responsibility of proper care and is also assured of every aid in maintaining roads, trails and fire breaks. The proposed charge would require an expensive board of surveyors and inspectors to insure its enforcement and offers a needless field for possible corruption.

Yet we must realize that any action taken must necessarily be with the approval and assistance of the Forest Service, whose teachings of thrift and efforts at conservation are most essential to our national welfare. A peaceable congress between the electrical powers of the coast and the electoral powers of the nation will do more than any forced legislation to accomplish the desired ends.

PERSONAL.

John Dale, owner of the Dale Company, manufacturers of Dale clusters, fixtures and portables, has been in San Francisco during the past week, and then will go to Los Angeles.

Abington J. Briggs, general manager of the Chicago Telephone Supply Co., was in San Francisco from Los Angeles recently. H. G. Aylesworth now has the San Francisco agency for the Chicago Telephone Supply Co.

Professor D. A. Lyon, of the geology and mining department of Leland Stanford University, Palo Alto, Cal., has been granted a leave of absence of six months to complete experiments upon a new electric smelter in the mines in Shasta County.

R. T. Laffin, who recently resigned the vice-presidency and general management of the Manila street car and electric lighting system, is in San Francisco. Manila now has about fifty miles of electric railway, which, with the electric lighting system, extends far into the suburbs.

The Indiana & Michigan Electric Co. is announced as the corporate name of the South Bend Electric Co., South Bend, Ind.; Buchanan Co., Buchanan, Mich.; Elkhart Electric Co., Elkhart, Ind.; St. Joseph & Elkhart Power Co., South Bend, Ind.; Berrien Springs Power & Electric Co., Berrien Springs, Mich. General offices will be maintained at 220-222 West Colfax Avenue, South Bend, Ind., and branch offices in each of the above-mentioned cities.

The United Railroads of San Francisco have announced the appointment of Joseph H. Handlon as chief claims agent, to fill a vacancy caused by the resignation of A. K. Stevens. Mr. Handlon has been chief clerk in the operating department since 1901. C. I. Kephart has been appointed chief clerk of the operating department. He has been assistant chief clerk for the last four years. Purchasing Agent C. D. Baldwin has also resigned, and his place has been filled by the promotion of Thomas Finigan, his assistant.

OBITUARY.

Dr. Coleman Sellers died December 28th, at Philadelphia, Pa., aged 80 years. As the most active member of the International Niagara Commission, he planned and executed the greater part of the Niagara electric installation. He was an honored member of almost all the engineering and scientific societies of the world. His work as consulting engineer was largely under the firm name of Sellers & Rippey, which is being continued by his surviving partners.

REMOVAL NOTICES.

The opening of the new year finds the electrical center of San Francisco assuming its former location. On New Montgomery Street between Mission and Howard Streets, we find H. W. Johns-Manville Co., Sterling Electric Co., formerly Century-Klein, A. G. Aylesworth, Standard Electrical Co., Van Emon Elevator Co., and the Journal of Electricity, Power & Gas. H. W. Johns-Manville Co. were the first to find permanent location at 159-165 New Montgomery Street in large, well-lighted quarters, giving every facility for the display of their many lines. Adjoining them in the same building the Sterling Electric Co. is now welcoming its friends to the newly occupied commodious ground floor office and salesrooms at 137 New Montgomery. Every aid is given for quick and convenient selection from a large stock of electrical supplies. H. G. Aylesworth has pleasant offices in the same building.

We have already noted the occupancy of 119-121 New Montgomery by the Standard Electrical Works, and recently the Van Emon Elevator Co. has taken the third floor of 111 New Montgomery.

The "Journal of Electricity, Power and Gas" is now permanently established in its new offices in the Technical Building at 111 New Montgomery, and cordially invites its subscribers to make use of the conveniences and comforts freely placed at their disposal. We have files of all the technical periodicals for reference, and are always glad to give information on matters electrical. This new location will be found central and readily accessible.

ELECTRICAL TRADES ASSOCIATION BANQUET.

A banquet is to be given by the Electrical Trades Association of this City at the Fairmont Hotel on Saturday, January 18th. This is a regular yearly affair with the Contractors' Association but they are endeavoring this year, to make it a more prominent one, by asking representation from all the branches, such as Telephone Companies, Electric Railroads, Engineers, Lighting Companies, Electrical Supply Houses, Municipal Departments, Contractors, etc. A social gathering of this kind including all those interested in the trade in any way should be of material benefit to all concerned.

In addition to provision for the inner man, it is proposed to provide enjoyable entertainment for the guests, which gives assurance that every one will have a royal good time. The banquet committee of whom C. E. Wiggin is chairman are working over-time to assure the success of the affair and hope that all the varied interests of the Electrical Trade will render proper aid by their presence and make this one grand affair. The manner in which the request for tickets are coming in assures this.

Cheer up, Boys! See that every one is on hand. The worst is yet to come.

TRADE CATALOGS.

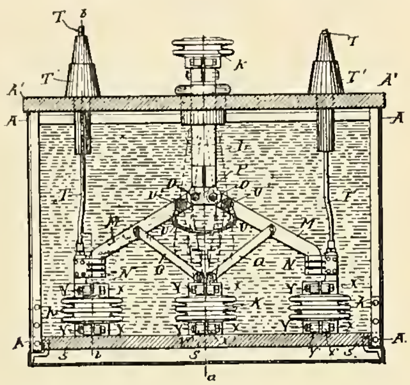
Spencer, Trask & Co., of New York City, send an interesting circular on "Investment Opportunities," showing the present advantages of buying bonds.

The Standard Electrical Works of San Francisco has for free distribution a number of copies of "The Simplex Manual," containing wire tables and data for all sorts of insulated wires and cables; also a booklet from the Jandus Electric Company treating of enclosed arc lamp troubles, due to improper conditions of operation, and offering valuable remedial suggestions.

PATENTS

SWITCH FOR HIGH-POTENTIAL CIRCUITS. 874,601. Joseph N. Kelman, Los Angeles, Cal.

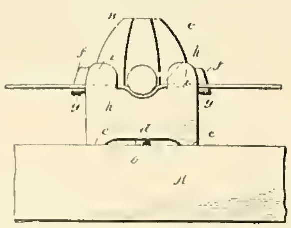
The switch and circuit breaker for high-potential circuits, consisting of two or more pairs of horizontally projecting poles or contact pieces with which oppositely operating switch blades make and break contact, the upper ends of each pair of said blades being connected to a rod of wood or equivalent insulating material, switch blades being pivotally connected near their center of length by links to pivotal connections on an insulator, attached to a beam of wood at the bottom of the tank, the fixed pieces or contact pieces being also attached to insulators fastened to a wooden beam within the tank, the conductors from the fixed poles or contact



pieces extending through insulators carried in the top cover of the tank, consisting of non-conducting material, the ferrules of insulating material at the center of the cover of the tanks, the wooden rods operating in ferrules, the clips connecting an insulator with the top of the wooden rod, the clips connecting the insulator to the channel iron, the connecting pieces and pivots by which the lower end of the wooden rods are connected to the upper parts of the switch blades, a flexible connection between the upper ends of the switch blades, the frames and guides between the center tank and each of the side tanks, the vertical rods operating in said frames and guides, the shaft, the lever and links and the counter weight for opening and closing the switch or circuit breaker.

INSULATOR. 874,445. Albert L. Shears, Seattle, Wash. Filed March 5, 1907, Serial No. 360,749.

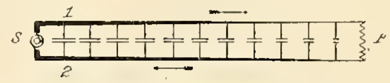
An insulator having a lateral projection and wire-receiving slots diverging from the projection; the outer side of the projection and the outer sides of the outer walls of the slots



being inclined upward and inward, and also having a portion tapered or inclined upward and inward from the upper side of the projection and the mouths of the wire-receiving slots.

SYSTEM OF ELECTRICAL TRANSMISSION AND PROPULSION. 874,411. Maurice Leblanc, Paris, France, assignor to Westinghouse Electric & Manufacturing Company.

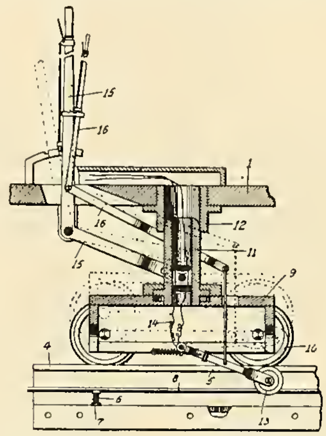
An electrical transmission line, carrying alternating currents of a wave length which is short with reference to the



length of the line, which has the ratio of its capacity to its self-induction artificially increased at points along the line in a manner to prevent the super-elevation of voltage, the consecutive distances between which points are short with reference to a half wave length of the current.

THIRD-RAIL ATTACHMENT FOR ELECTRIC CARS. 874,630. George H. Sohn, Lincoln, Cal.

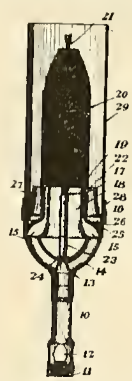
A hollow rail provided with a longitudinal slot in its upper face, a current-carrying wire disposed in rail, a dummy car carrying wheels normally running on rail, a hollow tube



upward from car, an electric car, a tube on the under side of electric car and telescoping first-named tube and means disposed within dummy car and tubes, conveying the current from wire to electric car.

INCANDESCENT GAS LAMP. 874,703. Alcorn Rector, New York, N. Y., assignor to Rector Gas Lamp Company, New York, N. Y.

A structure comprising a burner having a central draft tube, the lower end of draft tube being enlarged, a wall concentric with the draft tube forming a flue between itself and the draft tube, this wall being adapted to enter the lower



end of the mantle, a second wall concentric with the first wall and forming a circular flue delivering outside the mantle, tubes delivering air from the enlarged portion of the draft tube to the outer flue, a bunsen tube, tubes delivering air and gas from the bunsen tube to the inner flue, a motor mounted in the enlarged end of the draft tube and operated by the draft therethrough, and a blower operated by the motor.

INDUSTRIAL

THE DESIGNING OF ALTERNATING CURRENT GENERATORS FOR DIRECT-COUPLING TO STEAM TURBINES.

In articles previously published by this paper attention has been called to the features of construction, adopted by a leading builder of steam turbines, which have placed that company's machines in the position that they now occupy. The revolving field alternators which are direct-coupled to these turbines have been designed, with equal care, to meet the special conditions of turbine operation, an exhaustive study having been made of the successes and failures of earlier types, the good features retained, the bad rejected, and improved construction devised wherever improvements could be made. The objects especially sought were to give high efficiency, combined with simplicity and compactness; and especial attention is paid to the selection of material and methods of construction which insure absolutely safe operation at high speeds.

For the stationary armature of the turbo-alternators, every precaution is taken to secure thorough ventilation, so as to prevent heating of the armature core and winding. The laminated core, made of the best procurable electrical steel, thoroughly annealed and painted, is provided with numerous air ducts, and the cast iron frame is so formed as to assist in the circulation of air.

The armature coils are all completely formed in the shop so that no connections have to be made after the coils are placed in the armature core at the purchaser's station, except the connections of the coil terminals, thus reducing to a minimum the risk of defective insulation at joints. The advantage of this will be appreciated by station operators, especially for high voltage work.

The greatest care is taken in the insulation of the coils by successive drippings and bakings after the application of the various layers of insulation. The coils are firmly secured in the slots, and particular attention has been paid to the form of the coil ends and the securing of the same in such a way as to prevent deformation in case of a short circuit.

The field cores of the Allis-Chalmers Company's turbo-generators are, according to size and conditions, built up either of steel laminations, or of nickel steel forgings, of high magnetic permeability and great physical strength.

The slots formed in the core to receive the field coils are radial; a distinct improvement over constructions in which, to reduce the cost of manufacture, the slots are made parallel to chords of the cross section of the core. That this older form of construction results in complex stresses due to centrifugal force can readily be seen, and its weakness has been proven in practice; moreover, the field coils themselves are subjected to indirect instead of only radial forces, thereby making it difficult to procure an insulation which will not soon be injured by the centrifugal force. The method used, of winding the field with flat strap copper in radial slots, has been made possible by a specially designed forming machine which bends the copper edgewise and gives an increasing spread to each successive turn of the coil. The carefully insulated coils are firmly and substantially held in the slots by means of Parsons manganese bronze wedges. The revolving field is thus formed as a smooth surface cylinder, no matter what the number of the poles, thereby reducing the windage loss, besides tending to quieter operation than is possible with constructions which use projecting poles. Ample spaces are allowed at regular intervals between the laminations or discs of the core, to provide for ventilation of the core itself and of the coils, air being drawn in through openings formed parallel with the axis and discharged at the periphery. The ventilation of the ends of the coils is attained by allowing them to project beyond the ends of the core in such a way that they can be thoroughly cooled; the coils at this point being firmly secured against the effect of centrifugal force by means of nickel steel rings, which form an extension of the core and are provided with openings for the passage of the ventilating air current.

In revolving masses having high rotative speed there is, of course, a tendency to vibration, should the mass be out of balance even to the slightest extent; and if the natural period of such vibration should approximately coincide with the period of vibration of rotation, the cumulative effect may become serious. This is a matter which is too frequently lost sight of by designers, and has resulted in dangerous vibrations in many badly proportioned revolving fields. In the Allis-Chalmers generator particular attention is paid to this feature, and for each machine there have been determined such proportions of shaft as will cause the two periods of vibration to be as widely apart as possible, thus insuring safe and steady operation with minimum tendency to vibration.

For the purpose of obtaining adequate ventilation and for muffling the noise produced by the circulation of the air, these turbo-generators are enclosed in such a manner that the air is taken in at the sides of the machine, passing through fans which discharge it over the end connections of the armature-coils into the bottom of the machine, whence it passes through the ventilating ducts of the core to an opening at the top of the machine.

This system of ventilation is most efficient, as the air which is used for cooling the stator passes through a large and unobstructed area at the outer circumference of the stator, whereas any method of ventilation in which the air passes radially from the inside to the outside of the machine necessitates the forcing of this air through the narrow spaces between the coils. The coils, furthermore, deflect the air so that ventilation of this kind is inefficient, requiring a large amount of power and resulting in poor cooling.

On account of the high speeds of steam turbines and their generators, persons not accustomed to such speeds naturally feel some anxiety as to their perfect safety. This feeling has not been diminished by accidents which have occurred to a number of turbo-generators of a type of construction which has been avoided in the design of these machines, and, for the purpose of reassuring purchasers, Allis-Chalmers Co. has adopted the policy of testing every turbine and generator in its works to a speed twenty per cent in excess of the rated speed, thus subjecting the material to stresses forty-four per cent above the normal. This overspeed test taxes the machine, as it cannot be taxed in practice, for, even should the main governor fail to work, the safety governor will stop the turbine long before it reaches such a speed.

THE ENGINEERING DIGEST.

The Engineering Digest is the new name of Technical Literature, a monthly magazine of technical information for engineers, designers and constructors. It publishes an epitome of current articles in the technical press.

NEWS NOTES

TRANSMISSION.

San Diego.—E. H. Babcock states that the delay in the construction of the power plant for the electricization of the Lajolla line, is caused by the difficulty in getting a site at Morena.

Los Angeles.—The electric power plant of Los Angeles was considerably damaged by fire on December 24th, causing darkness in the city and stopping street car traffic. The roof of the plant was burned and partially fell on the machinery.

Redlands.—Engineer Pearson of the Edison Electric Company, is making surveys for repairing the damage done to the tunnel north of power house No. 1 by a slide which occurred last month. A conduit 500 feet long may be run into the mountain and lined with steel. The cost will be several thousand dollars.

Reno, Nev.—A party of five capitalists of Boise, Idaho, have organized a company known as the Kings Hill Irrigation & Power Company, for the purpose of erecting a power plant near Reno. The men who are back of the project and who have formed the company are Charles and Benjamin Hammett, C. B. Hurtt, E. L. Hice and O. O. Hage, all of Boise.

Santa Fe, N. M.—The Tusas Peak Gold & Copper Mining Co. of Tusas, New Mexico, has made application for a permit to appropriate from the public waters of the Territory of New Mexico. The appropriation is to be made from Wallecitos Creek and is to be conveyed to a power house by means of a dam, pipe and ditch.

Monrovia.—The contract for the installation of a new electric plant at the city well was awarded the Edison Company at a meeting of the City Council. The price is $11,450. The contract provides for a 100-horsepower motor and a cement pit five feet in diameter and 100 feet deep, from the bottom of which a twelve-inch drill will be put down 400 feet.

Oroville.—A. B. Bidwell, of Greenville, who is superintendent of the Meadow division of the Great Western Power Company's property, has commenced the work of obtaining rights of way for a pole line for the transmission of power. By way of explanation, the Meadow division includes all the rights and property of the Great Western Power Company in the vicinity of Prattville, Plumas County.

Oakland.—An entire block in East Oakland at White and Prospect Streets has been purchased for a sub-station by the Western Power Company. The site will be used for the erection of a sub-station at the end of the high tension line to be run from the Big Bend water plant on the Feather River. A main steam plant auxiliary of 30,000 horse-power is to be erected at Sessions basin at the foot of Sixth Street.

San Bernardino.—A project having for its purpose the development of water in the San Bernardino Forest Reserve for electrical purposes is being worked out by A. E. Poole. The government has granted Mr. Poole a right of way two and one-half miles in length. His scene of operations is within the watershed of the San Jacinto mountains. One of the series of power plants arranged for is at Palm Springs, on the desert in Riverside County.

Willows.—The Northern California Power Company, which supplies Willows with electricity, through its branch, the Willows Water and Light Company, has reduced the voltage on its main lines, as well as on the Willows line, from 40,000 to 20,000. This reduction will tend to lessen the accidents which have occurred of late; that is, since the wet weather set in, and also will assure the users of electricity of better service. The high voltage will again be placed on the lines next summer.

Reno, Nevada.—Representatives of the Telluride Power Company of Telluride, Colo., are looking over the ground along the Carson River with a view of purchasing sites for electrical power plants. The intention is to build at least two large plants, if the right power sites can be secured, and to furnish electric power for the mining camps in the western part of Nevada, as well as compete with the Truckee River General Electric Company, which now furnishes power to Reno, Carson and Virginia City.

Oroville.—The construction of the new power station of the Oro Water, Light and Power Company, at Coal Canyon, about eight miles from this city, is completed, and the machinery has been installed. A successful trial of the dynamos has been made. The company now has three power plants within fifteen miles of Oroville. The largest one, with a capacity of 5,000 horsepower, is above Pentz, about fourteen miles distant. The second, with about 2,000 horsepower, is at Coal Canyon, and the third and the oldest is at Thompson Flat, about ten miles from Oroville. The capacity of the last is less than 1,000 horsepower. The same water runs the water wheels of all three.

INCORPORATIONS.

Redwood City.—The Burlingame Water Company has been incorporated with a capital stock of $100,000 by G. F. Lyon, E. L. Hoag, H. T. Scott, G. A. Pope and D. H. McEwen.

Santa Ana.—Articles of incorporation have been filed by the Balboa Oil Company, which has a capital stock of $1,000,000. The incorporators are E. W. Fillette, W. H. Beman, Geo. Huntington, A. H. Wintrode, W. H. Bisbee and J. M. Percy.

Bakersfield.—The Springfield Oil Company has been incorporated with a capital stock of $500,000 by E. H. Loveland, L. C. Ross, H. P. Anderson, W. S. Kimball and A. T. Lightner.

Hanford.—The Mammoth Oil Company of Kings County has filed articles of incorporation with a capital stock of $100,000. T. L. Hannah, of Kingsburg; D. L. Phillips and W. A. Long, of Hanford; J. W. McCord, of Hanford; Chas. Latham, of Grangeville; C. A. Stephens and J. F. Warran, of Laton, are the directors.

POWER AND LIGHT.

Nampa, Idaho.—The new power house being built at this point by the Oregon Short Line for use in generating the power necessary for the block system is nearing completion. The interior is now being finished. It will be some time before the machinery is in place and the block system working, as the work of setting up the posts, etc., has not yet been completed.

Pomeroy, Wash.—The Tucanon Power Company is finishing the installation of the auxiliary power plant in West Pomeroy. This engine is capable of carrying the entire load of lights and power usual in the city. The smokestack is 60 feet high and three feet in diameter. The fly wheel weighs over five tons. This plant will not be used except when the water power fails.

Milton, Wash.—Application was made recently to the Puget Sound Electric Company for current for street lights. The company's reply was that "juice" is too scarce to take any new outside business. The Seattle-Tacoma Power Company also turned down the proposal for the reason that the demand in the field already occupied by the company is too great to permit of extensions into new territory. Now Milton is figuring on a water wheel in Hylebos Creek to make electricity on its own responsibility.

Vancouver, B. C.—The British Columbia Electric Railway Company is making extensive alterations at their power house for the installation of two 500-kilowatt transformers, equivalent to 1,500 horsepower. A portion of the floor for a length of 27 feet and about 10 feet in width is being torn up in the building to admit the concrete foundations to carry this enormous weight of machinery. The capacity of the plant as it is running at the present time is about 1,100 horsepower, and with the additional 1,500 horsepower the plant will be equipped for any emergency. The new switchboard, which will be shortly connected up, is made of finely polished marble and is believed to be the finest in any of the several plants of the company.

Nelson, B. C.—The city council and the Allis-Chalmers-Bullock Company, of Montreal, have locked horns over the machinery supplied by the company for the civic power and light plant at Bonnington Falls. The machinery has been in operation for nearly a year under an understanding between the council and the company, the city not having formally taken over the plant and holding back some $14,000 due the company on its contract. The city declares the machinery not up to contract, refuses payment of the balance and declines to accept the plant. The company asks for a forty-day shutdown to inspect the plant, the city declines to agree, and there the matter rests. In case of trouble, the Kootenay Power and Light Company will furnish Nelson with light and power temporarily.

Wallace, Idaho.—Articles of incorporation of the Northwest Light & Water Company have been filed with the county recorder. Carson City, Nev., is mentioned as the principal place of business, and the company is capitalized at $1,000,000, in shares of the par value of $100 each. The incorporators of the company, together with their holdings, are as follows: Robert E. Strahorn, A. G. Smith, R. J. Danson, and E. D. Doyle. While the report cannot be confirmed in Wallace, it is the general belief that the light and water plants at North Yakima, Wallace, and Sumpter will be consolidated. The owners of the local plant are known to control the others mentioned, and it is believed that the filing of the articles of the Northwest Light & Water Company is simply an initial step toward the merging of the interests.

TELEPHONES.

Stanwood, Wash.—The Pacific Telephone & Telegraph Company is constructing a line two miles north of Cedarhome.

Freewater, Ore.—The rural telephone company has elected the following directors for the coming year: E. P. Jensen, L. B. Nell, C. W. Steen, A. J. Williams, James Kirk. The line will be thoroughly overhauled.

Langley, Wash.—The directors of the Whidby Telephone Company, at their meeting here Monday, decided to run another wire to Clinton in order to give service to the many new settlers that are locating in this vicinity.

Toppenish, Wash.—The Home Telephone Company of Sunnyside, who have long-distance lines running to Toppenish, have their linemen here preparing to install a local system, which will finally be extended over the entire reservation.

Hermiston, Ore.—The Butter Creek Telephone Company is making arrangements to install an exchange in Hermiston the first of the year. It is understood that the company will make improvements here to the amount of about $5,000 in the way of extensions.

Puyallup, Wash.—A franchise for a new telephone system was granted to E. G. Pake. It must be completed within eighteen months. The city will have the use of the poles free for stringing fire alarm wires should necessity arise. It was stated the company is not identified with the Home Telephone Company of Tacoma, but has only arranged for long-distance connection.

Juliaetta, Idaho.—R. H. Porter, manager of the Potlatch Telephone Company, is improving the service. Mr. Porter has divided the farmer lines of Fir and Potlatch ridges into two lines each. There were too many on one line, but as soon as the work is completed there will be one-half the amount on one line as formerly. As soon as the work is completed here, Mr. Porter will start work on a line to Troy.

Kent, Wash.—The Independent Telephone Company, which has had long-distance connection with Seattle for some time, and has sixty farmers on its line around Kent, installed a large switchboard in Jack Kean's store, capable of handling 400 more telephones. They have 100 more subscribers in Kent to serve now and their officials are working now for more business in town. The Independent will soon have a line to Tacoma.

Wallace, Idaho.—The city council has granted Walter C. Clark and Daniel G. Price a franchise to maintain a telephone system in this city in opposition to the Rocky Mountain Bell Company. The system is to be in operation in six months from the date of the first publication of the franchise. The line will connect with the lines already built by Messrs. Clark and Price, and later with the Interstate Company's lines. Wallace has a population of 15,000.

Stites, Idaho.—Work on the Elk City telephone line has been resumed, and it is confidently expected that the busy little mining town will have wire connection with Stites by an independent company. The Stites Telephone and Electric Company, an independent concern, financed by local men, is stringing the wire, and the line will reach Newsome, the half-way station, by the last of the year. The line, when completed, will connect all towns between Stites and Oro Grande, the mining camps all being anxious to have the independent line enter their property.

TRANSPORTATION.

Richmond, Cal.—An ordinance granting to John Nicholl an electric franchise for a street railway, has been adopted by the Trustees.

San Francisco.—The Parkside supplemental franchise on Twentieth Avenue and two blocks of Nineteenth Avenue in Sunset has been passed.

Lakeport, Cal.—The town trustees have passed an ordinance granting an electric railway franchise to the Sonoma & Lake County Railway Company.

Phoenix, Ariz.—Andrew Nielsen, Redmond Toohey and Harry J. Bennett have applied to the Board of Supervisors for a franchise to construct an electric line to Mesa, along the Tempe road.

San Diego.—Bids will be received until January 7 by the Board of Supervisors of San Diego County for a franchise for a railway in the South San Diego Company's addition to San Diego.

Long Beach.—A franchise for the Pacific Electric Company's steam railroad on Ocean Avenue from Golden to Third, has been passed by the City Trustees. It is a fifty-year franchise and carries the privilege of an electric line.

Los Angeles.—Grading has begun for an extension of the Griffin Avenue line easterly through several canyons for a distance of two miles, to the top of Montecito Park addition. The Pacific Electric is to do the work, and the cost will come near $5,000 a mile.

San Francisco.—Since the North Beach plant is in successful operation, General Manager C. N. Black of the United Railroads has made a redistribution of power, which segregates the lines north and south of Market Street and makes the possibility of a complete tie-up of the car system very remote.

San Francisco.—As a result of a conference between President Stafford of the State Harbor Commission and Patrick Calhoun, president of the United Railroads, the three tracks nearest the west side of East Street of the seven that now lie between Market and Mission will be removed, giving 50 or 60 feet more room for teaming.

San Diego.—Work has been begun on the railroad for which a franchise was granted to W. H. Keller and C. H. Kirckhoff of Los Angeles. The line runs from Date and Atlantic Streets to Delmar, 18 miles up the coast toward Los Angeles. It is asserted that the franchise holders are backed by H. E. Huntington and that the proposed road will form a part of an extension of the Pacific electric system from Los Angeles along the coast to San Diego.

Visalia.—The Visalia Electric Railroad Company, now engaged in the construction of an electric car line between Visalia and Lemon Cove, and which will run its cars over the Southern Pacific between this city and Exeter, has obtained a lease of the Southern Pacific tracks between Visalia and Lemoore and will operate cars between these two cities. Work will be commenced on the electricizing of the line between Visalia, Hanford and Lemoore as soon as the line between Visalia and Lemon Cove is in running order.

Los Angeles.—If the deal now in progress between officials of Wells, Fargo & Co. and those of the various electric traction lines in this part of the State is brought to a successful conclusion, there will be a large increase in the service rendered by the express company and a corresponding benefit to people residing in the smaller towns within the Los Angeles territory. The plan is for Wells, Fargo & Co. to take over the business of the smaller express companies doing business on the electric lines, and to extend the service to every station, however small, along those lines. The first step in that direction will be the absorption by Wells, Fargo & Co. of the business of the Los Angeles-Pacific Express Company, which has been operating on Harriman's electric line to Santa Monica, Ocean Park, Redondo and intermediate points. The next step will be a similar arrangement with the Huntington system, and plans have already been laid in that direction. The small parcel business done by these lines is large, and the change will be of great advantage to people living in outlying communities, inasmuch as it will place them in direct express touch with the big railroad systems.

Los Angeles.—That Epes Randolph, representing E. H. Harriman, is expected to come to Los Angeles to re-organize the Los Angeles-Pacific Company is made evident by a statement made by R. C. Gillis, chairman of the executive committee of that corporation. When asked concerning the changes contemplated by the company, including the reduction in force, Mr. Gillis replied: "We will have no material changes except minor consolidation of offices. Our road is financed, and any future plans of reorganization that we have in view will await the arrival of Colonel Randolph." The rumors that General Manager T. R. Gabel would leave the company were denied at the offices in the Los Angeles-Pacific building and also by Mr. Gabel himself. He says: "The Los Angeles-Pacific will not be operated from the Pacific Electric building nor by any one other than its own officers. The financial condition of the company is the same as that of other large organizations throughout the country—thoroughly solvent, but hard up for cash. We just reduced expenses for the time being, but none of the improvements heretofore decided upon will be abandoned for plans changed, except that there will be a temporary curtailment of construction.

OIL.

Los Angeles.—A quarter-million-dollar plant for the manufacture of well tools of all kinds is a prospective addition to Los Angeles industrial projects. The Oil Well Supply Company of Pittsburg, Pa., has leased for a long term of years, the Griffith mill site on North Main Street, adjoining the yards of the Kerckhoff-Cuzner Lumber Company, and there proposes to expend $250,000 in building a factory. J. A. Graves acted for the Griffith estate in making the lease.

Martinez.—It has been rumored that the Bulls Head Oil Works of this city will shortly pass into the hands of a similarly named company from Maine, the consideration being something like $1,500,000. Financial embarrassment is given as the reason for the closing of negotiations which have been pending for some time. The absorbing factor is now to set about to place the works on a paying basis and will enlarge the plant and double the output of both crude and refined oil and kerosene.

FINANCIAL.

Lakeport, Cal.—The town attorney has decided that the water bonds are illegal.

Palo Alto.—The Palo Alto Gas Company is to issue $150,000 in 6 per cent bonds, redeemable in thirty years.

Redding.—The time of delinquency of the assessment of the Pacific Power Company has been extended to Jan. 3rd.

San Francisco.—The annual meeting of the Four Oil Company will be held January 16th, in the Kohl building. W. E. Miles is the secretary.

Visalia.—An assessment of 4 cents per share, delinquent January 20th, sale day February 8th, has been levied on the Devil's Den Oil Company.

Pasadena.—The City Council at its last special meeting voted to limit the municipal lighting bond to be asked for at this time, to $50,000.

Martinez.—The Pacific Telephone & Telegraph Company will hold its annual meeting of stockholders on January 2nd, at Ferry and Ward Streets.

San Francisco.—The annual meeting of the stockholders of the California Fortune Oil Company will be held January 16th, at 1300 Golden Gate Avenue.

Lindsay, Cal.—Assessment No. 16, of $1.60 per share, has been levied on the Nob Hill Water Company. The day of delinquency is January 15, and sale day February 3.

Sacramento.—The State has bought forty water, light and power bonds of the town of Santa Clara. The bonds are of forty years' issue, bearing 4½ per cent interest, and cost the State, with interest, $21,595.87.

Sacramento.—The State of California has bought forty water, light and power bonds of the town of Santa Clara. The bonds are of forty years issue, bearing 4½ per cent interest, and cost the State, with interest accrued, $21,595.87.

Redlands.—The new directors of the Bear Valley Mutual Water Company have chosen officers as follows: H. H. Garstin, president; A. E. Stedling, vice-president; Fred E. Hotchkiss, secretary. Progress was reported on the dam at Fillaree Flats. Later, another dam will be built 100 feet below the present one and 50 feet higher.

San Francisco.—The United Railroads has issued a report of the gross earnings for September, which shows receipts of 367,220, as compared with $423,199 for the same month of the year before, or a decrease of $55,979. The September report is considered by the officials as indicating a rapid return to normal business conditions. This is the third report the company has made since the beginning of the strike last May. The first was for June last, showing gross fares of $152,126, or a decrease of $296,329 as compared with June, 1906, when the receipts were $448,456. The second report was for August last, when the receipts were $317,769, as compared with $429,311 for the same month of the year before, or a decrease of $11,542.

Oakland.—The Realty Syndicate, owners of the Oakland Traction Company, the Key Route Railway System and largely interested in the Peoples Water Company, has decided to resume the issue of its short term investment certificates. These bear 6 per cent interest, payable semi-annually and may be surrendered for cash at any time provided six months written notice be given. In connection with this a statement dated Sept. 30th, 1907, has been issued showing total assets of $11,126,564.65. Of this total the stock of the Oakland Traction Company and the San Francisco, Oakland & San Jose Railway Company, the bonds of the Peoples Water Company and the capital stock of the California Improvement Company, makes $7,338,287.47. The bulk of the remaining assets consists of real estate and mortgages, contracts, etc.

ILLUMINATION.

San Jose.—The United Gas & Electric Light Company has ordered that all the wiring for the cluster lighting project in this city be placed underground.

Escondido, Cal.—Sig. Steiner and W. A. Sickler are active in agitating a campaign for an electric light and power plant, to be owned and operated by the people in connection with their water system, which has been developed.

Las Vegas, Nev.—An ordinance has been passed granting the Consolidated Light & Telephone Company of Las Vegas, Nev., the right to establish, maintain and operate an electric light plant in Las Vegas and for other purposes.

Corona, Cal.—The Corona Gas & Electric Company has made a contract with the Pacific Light & Power Company of Los Angeles, and will extend its line seven miles to connect up with the Pacific Light & Power Company's station at Pedley.

Turlock.—Joseph McDonald, of San Francisco, is trying to secure the assistance of the citizens in erecting a $25,000 gas plant here. He has discussed the matter with a number of leading business men and a petition for signature has been circulated.

Vallejo.—It is now assured that when the proposed bond issue for the enlargement of the municipal water supply is placed before local voters that there will be a proposition calling for the erection of and maintenance of a municipal lighting system.

Redwood City.—An ordinance was presented and adopted by the Board of Supervisors, granting W. J. Martin a franchise to maintain an electric light plant in the first township of this county for lighting and heating purposes and to operate wires and poles in the streets.

Woodland, Cal.—At a called meeting of the city trustees, a resolution was adopted citing the Woodland Gas & Electric Company to appear before the trustees and show cause why the franchise held by the company, known as the "Reith" franchise, should not be forfeited on account of the company's failure to comply with its provisions. The franchise was granted a few years ago and was to run for a period of 50 years.

Riverside.—The fact has developed in connection with the proposition for a new gas company in Riverside that the promoters of this enterprise plan to build a central plant at Colton and to pipe from that point "high pressure" gas to Riverside, Redlands, San Bernardino and probably to Highland. The same people who are exploiting the new company in Riverside are interested in the Home Gas Companies of Redlands, San Bernardino and Colton, and in the Lytle Creek Powers Company.

TELEPHONE AND TELEGRAPH.

Martinez.—The annual meeting of the stockholders of the Pacific Telephone and Telegraph Company is to be held here January 2d.

Modesto, Cal.—D. A. Conant has asked and obtained permission of the Board of Supervisors to erect and maintain a telephone line along the Salida road.

San Francisco.—President Casey of the Board of Public Works has issued an order that no more permits be issued to the Home Telephone Company to open streets for the laying of conduits until the thoroughfares already torn up by the corporation are placed in repair.

Colusa, Cal.—The stockholders of the Colusa County Telephone Company held their regular meeting at Williams last Saturday. The following officers were elected: Charles Schaad, president; W. T. Rathbun, vice-president; and J. M. Jones, secretary. The company expect to establish offices at Williams, Maxwell, Grimes, Princeton and Colusa by January 1st.

San Francisco.—A. S. Macdonald, an Oakland capitalist, and P. E. Bowles, president of the American National Bank of San Francisco, have sold, for $175,000, a frontage on Market Street of 25 feet and depth at that width of 90 feet. Its front on Stevenson Street is 50 feet, which is the width of the rear part of the lot, with a depth of 75 feet, the full depth of the piece being 165 feet. The lot lies between Sixth and Seventh Streets and is to be used for an office and "central" building by the Home Telephone Company.

Butte, Mont.—Former United States Senator W. A. Clark is at work in an effort to settle the troubles between the labor unions and the Rocky Mountain Bell Telephone Company as the result of the sympathetic strike of the linemen and the switchboard operators. He was asked to serve in the capacity of mediator by the labor interests, and has met with representatives from the telephone company and the labor unions. A stumbling block in the way of a settlement is the refusal of the company to remove the injunction recently granted by the Federal Court restraining the unions from any interference with the affairs of the telephone company. Attorneys for the telephone company are busy collecting evidence against the labor leaders implicated in the deportation of non-union linemen from Butte, in violation of the restraining order. The linemen deported have been brought back to Butte and are again at work under a heavy guard of plain-clothes men.

ILLUMINATION.

Globe, Ariz.—Messrs. Cottee and James have sold the electric light and gas plant of this city to A. F. Gressler and W. D. West. Mr. Gressler states that a considerable amount of money will be expended in increasing the capacity of both the electric and gas plants.

Needles, Cal.—C. F. Schrader, who obtained a franchise for a gas and electric lighting plant at Needles, expects to commence the erection of the plant within 90 days, and have it in operation by April 1st, 1908. The franchise is for 50 years and calls for the plant to be completed and running inside of three years. George F. Moser will be general manager and T. A. Johnson secretary and treasurer of the plant.

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XX. SAN FRANCISCO, CAL., JANUARY 18, 1908 No. 3

UNIQUE GAS ENGINE AND STEAM ENGINE ELECTRIC STARTERS.

In starting steam engines and gas engines of very high power, electric auxiliary apparatus is utilized to great advantage. Engines of several thousand horsepower are usually provided with very heavy flywheels or revolving fields of alternators on direct connected sets, which required considerable power to start from rest, when the working power of the engine is not readily applied.

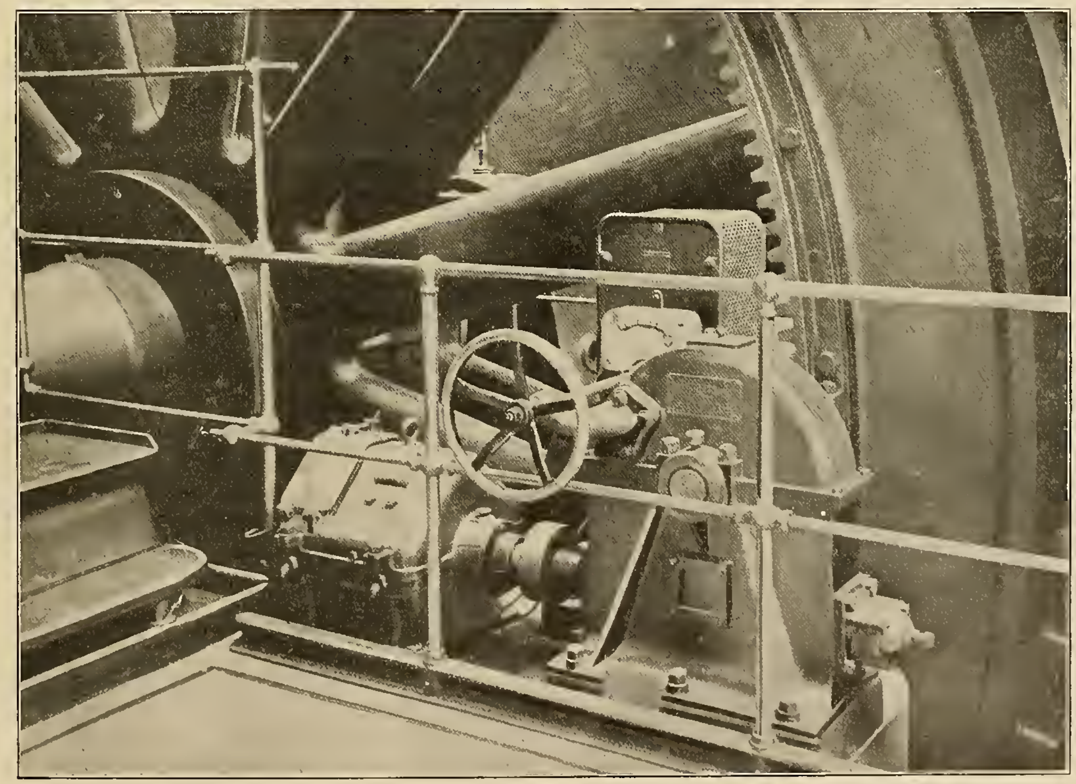


FIG. 1. ELECTRIC STARTER FOR 6000 H. P. ENGINE.

The accompanying illustrations and drawing show the details of construction and method of operation of two or three novel types of German electric starting devices of more than passing interest.

The electric motor-driven starters noted in Figs. 2 and 3 have been installed on the 2,000-horsepower and 3,000-horsepower engines in the power houses of the Electric Central Stations at Duisburg and Charlottenburg, Germany, also at the power plant of the "Schiffswerft, Harland & Wolff, in Belfast, Ireland.

The motor used is of 6-horsepower capacity, operating at 750 revolutions per minute, the pressure at the pitch line being 2,000 to 3,000 kilograms in starting these heavy flywheels. The above motor is of the direct current type, operating on 220-volt circuit. Where three-phase motors are used of 50 periods, with a pressure of 500 volts, a larger motor of 10-horsepower capacity is used, operating at 725 revolutions per minute.

As soon as the engine has reached the proper speed and is working by its own power, the electric starting motor is automatically, mechanically and electrically from the large engine sets and comes to rest.

At the Electric Station of the Charing Cross Company,

in London, England, the type of electric starter noted in Fig. 1 was installed by the Felten & Guilleaume-Laymeyer-werke, of Frankfurt-a-M., Germany, for bringing the 6,000-horsepower steam engines into service.

This equipment includes a direct current motor of 9-horsepower, operating at a speed of 670 revolutions per minute, the pressure at the pitch line being 3,800 kilograms

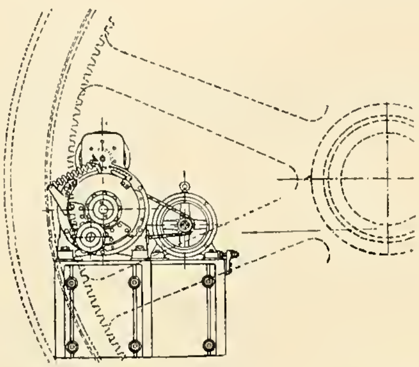


FIG. 3. ELECTRIC STARTER FOR 3000 H. P. ENGINE WITH CHAIN MOTOR DRIVE.

to 6,000 kilograms on these large units, requiring starting by gearing to the inner part of flywheel rim.

Equipments of this size for starting high power gas engines, driving alternators, where three-phase alternating current is to be utilized with a frequency of 50 cycles and 500 volts pressure, require the installation of a polyphase

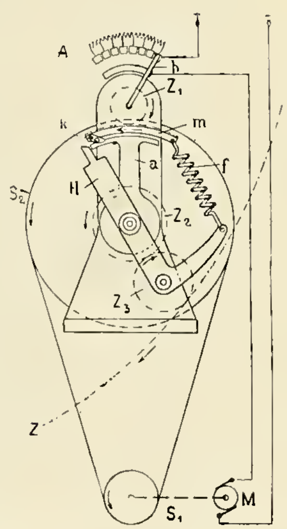


FIG. 4. MOTOR STARTER, ELECTRIC CONNECTIONS AND CUT OUT MACHANISM.

motor of 14-horsepower capacity operating at 720 revolutions per minute.

It will be noted that the electric power is transmitted to the pinion on the flywheel rim by chain drive from the electric motor armature in the outfits starting the 3,000-horsepower engines, while direct connection through worm gearing is employed on the electric starters noted in Fig. 3 for the 6,000 horsepower engine sets.

The accompanying drawing, Fig. 4, shows the electrical connections of this equipment, and mechanical automatic apparatus, M being the starting motor, A the starting

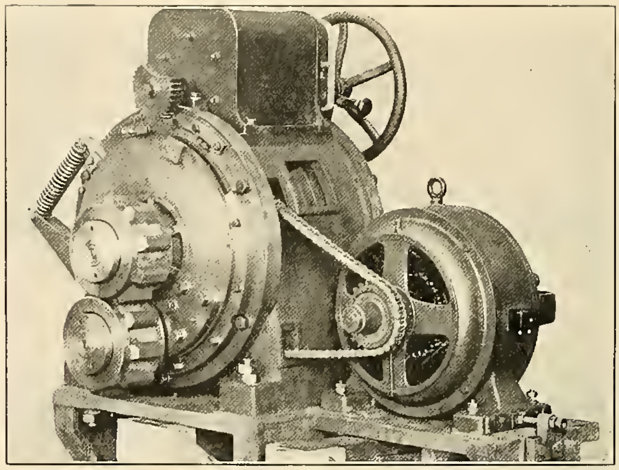


FIG. 2. ELECTRIC GAS ENGINE STARTER.

rheostat, Z Z toothed pinions, and H, and F the lever and spring, determining the speed at which the device is automatically cut out.

All the switches of the Pacific Telephone and Telegraph Company in San Francisco have been changed to "local" lines. This will extend the local service to Oakland, Berkeley, Alameda, the smaller connecting cities on the Alameda side, San Rafael and the cities down the peninsula. Instead of a separate telephone directory for each city, one large book will contain the names and addresses of the subscribers in the bay cities. The long distance operator is to be eliminated under the new system, as far as the service about the bay is concerned. The cities comprised in "Greater San Francisco" will be connected by direct trunk lines. This will enable the company to eliminate the delays whch now intervene in the transbay switches. The result will be a quicker service for all points about San Francisco. With the inauguration of the new system came a reduction in rates. The company will extend the time permitted for a call from one city to another from one minute to three minutes for the same charge of 15 cents.

Three-phase alternating current locomotives are to be used on the 140 miles of the Arlberg road between Innsbruch and Feldkirch, Switzerland, supplanting an existing steam system. An output of 3,000 horsepower is demanded from a locomotive weighing 60 tons or less, an impossible condition for single-phase or direct current locomotives at present. Electric braking and regeneration of power by descending trains is to be employed. A 40,000 kilowatt hydro-electric station is projected to supply power for fifty locomotives. Prof. C. L. de Muralt, of the University of Michigan, has been selected as consulting engineer by the Austrian Government.

Frosted bulbs have shorter lives than clear-bulb lamps, and also become hotter. This is not due to any decrease in the filament life, but to the greater light absorption with deposited carbon. In the December issue of the "Bulletin of Standards," Dr. Ed. P. Hyde and F. E. Cody designate the light-decreasing effect of frosting as the "change of absorption," and find that it amounts to six per cent for seasoned lamps.

STREET LIGHTING IN 1907.*

By Alton D. Adams.

England has shown a relatively large increase of gas lamps in spite of electric competition, and it has also put into extended use automatic systems of gas street lighting, inverted street burners, and high-power gas lamps that dispute the places of electric arcs in some of the most important thoroughfares. In the United States, on the other hand, open flat-flame street lamps have been displaced by nothing more imposing or attractive in the way of gas burners than the upright mantle giving some 50 candle-power when new, and lighted and extinguished with the irregular rounds of the lamp boy.

Automatic systems of gas street lighting, as applied in England, depend either on a small clock mechanism at each burner, or on a momentary increase or decrease of pressure in the mains, to start and extinguish the lamps. When the gas is automatically turned on, the lighting is done by a minute pilot jet that burns constantly. Among numerous places in England where automatic gas lamps are in use for street lighting may be mentioned Tottenham, which has over 1200 such lamps.

In Tipton, England, 456 gas street lamps were equipped with an automatic lighting attachment during the past year, and it was found that the six persons formerly employed to clean, repair, light and extinguish the lamps could be replaced by two, with a resulting saving in wages of more than one thousand dollars annually. Under the system of hand lighting and extinguishing, an average of 12 mantles and 9 chimneys had been required per lamp per annum, but with automatic lighting the average for each lamp was reduced to 6 mantles and 15-100 chimney per annum. The saving of gas by the automatic system, due to the fact that lamps are burned during only the hours when wanted, is much larger than the consumption by the pilot jets. The cost of installing the automatic lighting apparatus at Tipton was under five dollars per lamp.

Since the erection of some 6,000 inverted mantle burners to light the streets of Edinburgh, Scotland, in 1906, the adoption of this type of gas street lamp has been going on rapidly in the United Kingdom. These inverted burners were selected for street lighting in Edingburgh after tests of durability, gas consumption and candle power that ran back to June, 1904. Fourteen makes or types of inverted gas burners were tested, and the burner selected showed a consumption of 2.2 cubic feet of gas per hour at a water pressure of two inches, and gave at this consumption 72 horizontal candle power or 32.73 candle power per cubic foot of gas per hour. This high efficiency is due in part to the excellent quality of Edinburgh gas, which has a gross heating power of about 700 British thermal unit per cubic foot. As adjusted for street service, each of the inverted burners at Edinburgh consumes 2.25 cubic feet of gas hourly at the water pressure of two inches, which amounts to 9,000 feet of gas during 4,000 hours of lighting, a not uncommon duration annually for street lighting.

Among the fourteen types or makes of inverted burners tested at Edinburgh the candle power obtained per cubic foot of gas consumed per hour varied from 14.16 up to 32.73 candle power mentioned for the burner selected, showing the importance of the best construction in such burners.

Besides the higher efficiency and lower gas consumption of inverted mantle burners, as compared with the ordinary upright type, the inverted burner is better suited for street lighting by reason of its superior distributive power of the light developed, and because of its more artistic appearance.

Large incandescent gas lamps, containing several mantles each, and having special interior constructions according to the make, are being made in both England and the United States for the development of candle powers that compare more or less favorably with those of electric arcs.

These large gas lamps with groups of mantle burners, sometimes called gas arcs, are made in England for a gas consumption of as much as fifty cubic feet per hour each, and to develop up to at least 1,500 mean spherical candle power. In these lamps the efficiency of 30 or more mean spherical candle power per cubic foot of gas burned per hour, which is decidedly above that of ordinary mantle burners, is obtained by a thorough mixing of the air and gas, and by heating the mixture before it reaches the mantles, so that a rapid rate of combustion and high temperature are developed.

Competition for the public lighting has brought large numbers of these high-power gas lamps on to important streets in various cities of England, and in London they are lighting the streets at Parliament Square, Buckingham Palace, the Mansion House, and Oxford Circus, among other points. A high-power mantle gas lamp using 30 to 50 cubic feet of gas hourly, and developing 1,000 to 1,500 mean spherical candle, is a strong competitor of the best forms of electric arcs, especially in view of the fact that the gas lamp gives its strongest rays of light in a nearly horizontal direction, so that they reach the ground at distant points.

High-power gas lamps are being adapted to interior lighting to quite an extent in the United States, but as yet little or nothing has been done with them here for street lighting purposes. Large numbers of open flat-flame gas burners are still used for street lighting in this country, and give probably no more than 10 to 15 candle power each, though the gas consumption may easily reach eight to ten cubic feet per hour with the high pressures now common in the mains. Such open burners for street lamps impose a double loss on the public, and should be replaced with mantle burners or electric lamps at once.

Both England and the United States are using large numbers of the ordinary single mantle upright gas burners for street lighting, and on this side of the ocean, at least, the horizontal candle power of such burners when new is probably seldom above fifty. Such burners have a normal consumption of about 3½ feet of gas per hour, and an actual consumption that depends on the pressure in the pipes where they are attached, and on the burner adjustment.

On the basis of 3.5 feet of gas per hour, the consumption of one of these upright mantle burners reaches 14,000 feet during the ordinary lighting period of 4,000 hours per year, so that the cost of dollar gas for this period is fourteen dollars. With a reasonable amount added for the care of the burner, including the renewal of mantles, so as to bring the total annual charge up to not more than twenty dollars per lamp, these upright burners are strong competitors of incandescent electric lamps, but the force of this competition vanishes when the annual charge for the gas lamp goes up to from $25 to $35.

In England, the practice is for each gas company to operate the gas street lamps within its area of supply, but in the United States there has grown up the peculiar practice of contracting with a foreign corporation to light city streets, in cases where gas is to be the illuminant. The foreign corporation then buys the necessary gas from the

*Condensed from "Municipal Journal and Engineer."

local company, and collects the agreed price from the city. Just how the extra pickings incident to this method of doing the business are divided between the several parties the data available does not show.

Electric street lighting has fared much better than that with gas in the United States, and in the matter of metallic arc lamps, at least, this country appears to be leading England at the present time.

A recent investigation of electric street lighting in forty-one cities and towns of Great Britain gives interesting data of the conditions there as to the relative numbers of the several types of lamps in use for this purpose. In the forty-one cities and towns, it appeared that 11,761 arc street lamps were in use, of which 9,371 were of the open type, 2,007 were inclosed, and 377 were the so-called flame arcs. Besides these arc lamps, there were 8,760 columns carrying various forms of incandescent electric lamps.

The fact that 9,371 of the 11,761 lamps were open arcs shows a marked contrast with the practice in the United States, where inclosed arcs now far outnumber the open. One of these flame arcs operated with about 400 watts is capable of developing 1,800 maximum and 1,300 mean hemispherical candle power, but this maximum occurs between 40 and 50 degrees below the horizontal, and most of the great volume of light reaches the ground within a few feet of the lamp. This type of lamp thus produces in an aggravated form the undesirable inequality of street illumination that has ever been characteristic of arc lighting. With a short life of carbons like that in the ordinary open arc, the flame arc also involves a relatively high cost of carbons because of their loading to produce the incandescent vapor that yields the high candle power.

Reason for the large displacement of open by inclosed arcs, in the United States, in contrast with the English practice, is mainly found in the cheaper operating qualities of the inclosed arc equipment both inside and outside of electric stations. The inclosed arcs if of the alternating type, as is more commonly the case, obviate the operation of arc dynamos, and take energy from the generators that carry the incandescent light and the motor load, through constant current transformers. A material increase in the efficiency of operation results from this change. While the double open arc lamp must be trimmed after about ten hours of burning, and then requires two pairs of carbons, a single pair of carbons lasts one hundred or more hours in the inclosed arc, and the latter thus effects a material saving of both carbons and labor.

During the past year, a new type of arc lamp, in which electrodes of copper and of metallic oxides take the place of carbons, has been installed for street lighting in a number of cities, and bids fair to find extended use for this purpose. Owing to the metallic nature of the electrodes between which the arc is formed in this type of lamp, the period of its operation from one trimming to another is said to reach 150 or more hours, with a correspnding reduction in labor, and the cost of the metal electrodes is much less per hour than that of carbons in the open arc. In the ratio of energy consumption per candle-power hour, the metallic-oxide arc does not equal the flame arc, but the former gives a stronger light at angles near the horizontal, and is much better suited for street illumination.

One make at least of this metallic-oxide arc operates with not over 300 watts of direct current, and this lamp is being installed to replace open arcs that run on 450 to 500 watts each. A case in point is that of Louisville, where some 2,400 of the open type have been replaced with the metallic arcs. This metallic arc shows a reduction of nearly 40 per cent of the energy required by the 480-watt open arc, and there is also an important saving in the labor of trimming, so that the introduction of the former may fairly be accompanied by materially lower rates.

Incandescent electric street lighting has lagged far behind its proper development in the United States, in part, at least, because of the low efficiency and high operating costs of lamps available for the purpose. Street lighting is so scattered that it is usually very desirable to operate the lamps on series circuits for this purpose. For such circuits the highest efficiency of available lamps with carbon filaments has generally been 3.5 watts per candle power, though the carbon lamp has been made to yield a candle power for every 3 and even 2.5 watts, on constant pressure circuits. With rates based on the 3.5 watt series lamp, it has usually been possible to obtain more street lighting for a dollar with the incandescent gas mantle than with the carbon filament.

There is no longer good reason or excuse for the conditions just noted, for the new tantalum and tungsten filaments are both especially suitable for series connection, where the lamp voltage is relatively low, the current large, and the incandescent strand thick and stout. In the construction of tantalum and tungsten lamps for the ordinary 110-volt circuits, the most serious problems are due to the relatively great length and small diameter of the wire that is to carry less than one-half an ampere. When the volts per lamp may easily be 10 to 15, and the current several amperes, as in series working, the cost of lamp construction is evidently reduced for these metal filaments.

As the tantalum lamp yields a candle power for 2 watts, and the tungsten lamp a candle power for not more than 1.2 watts, the application of these metal filaments to electric street lighting should lower the cost and largely extend the service; and it is probable that the coming year will see progress in this direction.

THE WISDOM OF BOB THE SHIFTMAN.

1. If a circuit-breaker comes out on night shift, wait; another may follow, and this will save you getting up twice.

2. If a fly-wheel burst and brings down the main steam-pipe, do not rush for the door; other collectors of fresh air will be using it. Try the window.

3. You look after the volts; the amperes will look after themselves.

4. Overloads are deceptive. Many plants will climb a peak, but they will not therefore walk along a plateau.

5. Never admit that the volts were back at eight o'clock last night.

6. When David said: "All men are liars," he must have been thinking of our junior's section of the log sheet.

7. No man is perfect. The engineer who repaired a broken crank-shaft while the machine was running, still has to keep his hands in his pockets till his landlady has mended his braces.

8. If you are determined to switch in the 1,000 kilowatts set exactly out of phase, make a job of it, so that no one else can do it for weeks.

9. The surprise of Jezebel when she was pushed out of the window was nothing to that of our volt boy when he hung his tea-can on the terminals of the main voltmeter.

10. A machine that won't excite itself very often excites the engineer in charge.

11. One of the disadvantages of mechanical stokers is that they cannot make a fourth at Nap.

12. Asking the chief for a rise, when the manhole covers are flying about like kites, is asking for trouble.—The "Electrical Review."

ELECTRICAL MEN HAVE AN OUTING.

Thursday afternoon, January 9th, some thirty convivial souls left San Francisco, on the Monterey Express, for Del Monte. At the beginning, it had somewhat the appearance of a "pipe dream," as Mr. Alex. Henderson, representing the American Circular Loom Company, of Chelsea, Mass., presented to each of the delegates a briar pipe, neatly incased in a box. Cigars were tabooed, and the pipe of peace and plenty was smoked from that time. A warm welcome awaited the delegation by one of the most genial of managers, Mr. H. E. Warner. After dinner, cards, billiards and music were in order until a late hour. Friday morning was devoted to a feast of reason, the afternoon to automobile sight-seeing of the scenic and historic interests of the vicinity.

One of the happiest surprises of the trip was a noon banquet, given by our genial friend, Mr. Alex. Henderson. The table was most daintily decorated with carnations and ferns, and a boutonniere at each plate. The menu consisted of the choicest of viands from the larder and vintage. The table was set in the main dining room, far enough removed from the regular guests so that the toasts and speeches did not seem to disturb them. The writer noticed that many of them remained throughout the entire banquet. It seemed that they, too, enjoyed the flow of good spirits.

HENDERSON has been visiting the Pacific Coast in the interest of his company for the past six weeks. His first visit was made five years ago as the representative of the Sprague Electric Co. Two years ago he assumed his present position with the American Circular Loom Co. His address to the delegation was not only expressive in the language used, but carried with it a sentiment echoed in the heart of each and every one of the members present that they, too, might some day have an anchorage. He told of his boyhood experiences in a far Australian village, alone, stranded and homesick. One day, while strolling near the wharves, he met by accident the master of a sailing ship, to whom he applied for a position. By good fortune, as he thought at that time, the captain gave him a berth before the mast. The trip, from the time they left Australia until they finally reached the harbor of New York, some two hundred and forty-four days, was fraught with hardships that but few are ever called upon to bear. Storm after storm they encountered, and fought as only sailors in desperation fight for their lives. Finally, when the anchor chain rattled, and the old mud-hook held fast, there seemed but one thought in the hearts of the entire crew, and that was "Thank God, we have anchored at last!" That thought seemed to have grown in strength from time to time during some thirty-

Courtesy Hotel Del Monte.

WHERE THEY MET—HOTEL DEL MONTE.

five years of active business life, always the light in the window, on the rock-bound coast of this great sea of trouble and care, placed there by the good mother, guiding him even as it does the mariner. It was his dream to have in his declining years an "anchorage," a home where he could welcome his friends, and again enjoy that perfect peace and contentment that those sailors felt at the moment of safety in the sheltered harbor. This dream has been realized by the purchase of several acres of land in a beautiful spot in the New Hampshire hills, in the neighborhood of Boston. There he has built a modest cabin home, and has named it "The Anchorage," where he has invited all those in the electrical profession, who at any time come within hailing distance of his den, to visit him. As he expressed it, "the latch string will not be hanging on the outside, for there is no latch string, but the welcome will be just as warm." A standing toast to his long life and contentment in his chosen spot, was given with a hearty good will.

T. E. Bibbins, R. W. Van Valkenberg. W. A. Landry. C. A. Gilsen, B. C. Holst, A. W. Ballard, F. V. Carter, G. A. Knoche, E. B. Strong,
A. H. Elliott, R. J. Davis, H. C. Thaxter. C. C. Hillts, Alex Henderson, S. B. Gregory, E. M. Scribner,
W. L. Goodwin, seated, F. N. Fobes, R. D. Holabird.

Friday evening, as the invited guests of the jobbers, the manufacturers and manufacturers' agents arrived, and met at the grand banquet of the occasion. To describe the banquet table would require a more able pen than that of a technical writer. Suffice it to say, that the cloth was spread with the most delicate of china, glassware and linen. The floral decorations were stemmed violets and maiden-hair fern, orchids, and many other of the choicest blooms to be found in any part of the world to-day. The hollow square around which the tables were set was filled with ferns and gorgeous leaf plants.

The menu card was not only unique, but very handsome in its design. On the cover an incandescent lamp with a wire from a shell and spray of sea fern connecting the socket, the lamp being mortised out to show an exquisite scene of the Hotel Del Monte, in colors.

The menu itself is worthy of history, as will be found by reading the following:

MARTINI COCKTAIL—"HOW."

BLUE POINTS.

"Fruits of the sea and shore, all dainty and delicious."

CREAM OF CELERY, LIVINGSTONE.

"Taste of it first."—King Richard II.

CONSOMME BERCHOUX.

"A Hot friend cooling."—Julius Caesar, IV:2.

OROVILLE RIPE OLIVES. CELERY EN BRANCHE.

"The simple olives, best allies of wine."—Byron.

SALTED ALMONDS. MIXED PICKLES.

"To think that only toothsome which can bite."—Edward Hyde to T. Randolph.

BOILED STRIPED BASS, SAUCE HOLLANDAISE.

"I shall no more to sea, to sea,
Here shall I die ashore."—The Tempest.

POMMES DE TERRE, DUCHESSE.

SUGAR CURED HAM, CHAMPAGNE SAUCE.

CRAB MEAT, A LA NEWBURG.

TENDERLOIN OF BEEF, LARDED, FINANCIERE.

"Inventions to delight the taste."

PINEAPPLE FRITTERS, MARASCHINO SAUCE.

"Give us the luxuries of life, and we wil dispense with the necessaries."—Motley.

SORBET DEL MONTE

"Then farewell heat and welcome frost."—Shakespeare.

ROAST SPRING CHICKEN AU CRESSON.

"The Justice,
In fair round belly with good capon lined."

ROAST PRIME RIBS OF BEEF.

BOILED AND MASHED POTATOES. STRING BEANS.

SPINACH IN LEAVES AU BEURRE.

"How green you are, and fresh."—Hood.

BAKED HUBBARD SQUASH.

HEARTS OF LETTUCE.

"My salad days, when I was green in judgment."
—Antony and Cleopatra.

LOBSTER MAYONNAISE.

"Let onion atoms lurk within the bowl
And, half suspected, animate the whole."—Sydney Smith.

HOT MINCE PIE. VANILLA CUSTARD PIE.

FIGARO PUDDING WITH WHIPPED CREAM.

"When I have tasted of this sacred dish."
—Beaumont and Fletcher.

NEAPOLITAINE ICE CREAM. TANGERINE SLICES.

"I always thought cold victual nice;
My choice would be vanilla ice."
—O. W. Holmes—Contentment.

FRUITS IN SEASON. NUTS AND RAISINS. FIGS.

"Praise us as we are tasted."

ROQUEFORT. BRIE. EDAM. RANCHO DEL MONTE.

CRACKERS. DEMI TASSE.

"Oh, 'tis excellent to have a giant's strength."
—Measure for Measure, 11:2.

CREME DE MENTHE. COGNAC. CIGARS.

"Some smoke here, some hereafter."

Mr. T. E. Bibbins, of the General Electric Company, as usual, in his happy way, acted as master of ceremonies. It has been the privilege of the writer to attend many gatherings of this kind, but we say it without any intention of flattery, Mr. Bibbins as toast-master is prince of them all. He honored Mr. C. C. Hillis with the first call for a speech, and from that moment the fun began. Mr. Holabird (the silent) called for a point of privilege, and was allowed to make a few remarks. Then, in an able manner, Mr. Hillis told a few things he knew. For fear of being accused of hyperbole, the writer will not endeavor to repeat any of the speeches of the evening. Mr. E. M. Scribner, of the California Electrical Works, was the next speaker in order. He told a quiet little story—we'll stop right there. A song from Mr. Holabird, accompanied by the orchestra, the violin and harp, entitled the "Hoola Hoola," was next in order. Those who responded to toasts were, in the order named: Mr. F. E. Corwin; Mr. J. Froesch, of Los Angeles; Mr. R. J. Davis, of the Standard Electrical Works; E. B. Strong, The "Press"; Mr. Alex Henderson; Mr. John R. Cole, the old pioneer, of the John R. Cole Company; Mr. Garnet Young, of the Telephone and Electric Equipment Company; Mr. Will Goodwin, of the Sterling Electric Company, subject, "Air Brakes"; Mr. Drendell, of the Drendell Electric Manufacturing Company; Mr. Knoche (and all the boys liked him); Mr. Van Valkenberg, of the California Electrical Works, on the subject of "Credits" (how much have you got?); Mr. Holabird, with more stories; Mr. Pierce, of Shelby Incandescent Lamp Company; Mr. C. E. Winchell, of H. W. Johns-Manville Company; Mr. A. H. Elliott, Oakland's boy orator, and others.

Mr. R. J. Davis introduced a very happy resolution that was unanimously carried that each new addition to the electrical fraternity presented by the wives of the members would receive a loving cup. A very substantial collection was taken up, and Mr. John R. Cole and Mr. H. C. Thaxter would do well to prepare their little speeches, as they surely have something coming.

Good cheer, song and music lasted until an early hour. When the convention closed, it was with a good fellowship that Mr. Elliott, in most eloquent language, impressed upon the minds of all the purpose for which these conventions are held, bringing closer together not only the wholesalers, but the wholesalers, manufacturers and contractors. And it did seem that the object had been fully attained.

Most of the guests left on the early train Saturday morning, a few remaining over to enjoy the beauties of the place and the many interesting surroundings. The weather was perfect, with just enough crisp in the air to make it invigorating, and yet, to an Easterner, it would be considered as a balmy day in June.

Those present were: T. E. Bibbins, General Electric Co.; C. C. Hillis, Electrical Appliance Co.; F. E. Corwin, Bryant & Perkins Co.; W. A. Landry, Dunham, Carrigan & Hayden; G. A. Knoche, Dunham, Carrigan & Hayden; A. D. Pierce, Shelby Incandescent Lamp Co.; Edw. Preston, Standard Undergonnd Cable Co.; C. E. Winchell, H. W. Johns-Manville Co.; Garnett Young, Telephone & Electric Equipment Co.; F. V. Carter, Pacific Electrical Works; S. B. Gregory, Brooks-Follis Electric Co.; Alex. Henderson, American Circular Loom Co.; W. L. Goodwin, Sterling Electric Co.; A. H. Elliott, Oakland's boy councilman; H. F. Froesch, Federal Electric Sign Co.; J. R. Cole, J. R. Cole Co.; E. M. Scribner, Western Electric Co.; A. E. Drendell, Drendell Electric Mfg. Co.; R. J. Davis, Standard Electrical Works; H. C. Thaxter, Standard Electrical Works; C. A. Gilsen, Crescent Electric Co.; R. D. Holabird, Holabird Reynolds Electric Co.; A. W. Ballard, General Electric Co., Los Angeles; R. W. Van Valkenberg, California Electrical Works; B. C. Holst California Electrical Works; E. N. Fobes, Fobes Lamp Co.; Wm. A. Ekberg, Manufacturers' Agent; E. B. Strong, "Journal of Electricity."

The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
SUCCESSORS TO
The Journal of Electricity Publishing Company
111 New Montgomery St., San Francisco

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

Vol. XX JANUARY 18, 1908 No. 3

EDITORIAL.

WIRELESS TRANSMISSION.

Throughout Dickens' most beautiful characterization of child life, Paul Dombey's constantly recurring conundrum is, "What are the wild waves saying?" This beautiful thought, like many others, has become commonplace, and is now too often applied facetiously. But every enigma will ultimately be solved even as was that of the Sphinx and today we are understanding what one wave variety, the Hertzian, is saying, having partly tamed its wild nature to our needs. For these electro-magnetic waves, most of whose properties were mathematically forecasted by Clerk Maxwell over forty years ago, long before they were experimentally discovered by Hertz, are the medium of wireless transmission, whether telegraph, photograph, telephone or power. Even he was unable to apply them practically, and it was not until Marconi perfected his wireless telegraph that this promising infant was born. Its baby growth has been rapid, being nurtured under the direction of the Telefunden, De Forest, Fessenden, Shoemaker, Lodge-Muirhead, and other systems now so numerous and successful that Marconi stations constitute only about one-fifth of the fifteen thousand stations throughout the world. An account of the fundamental principles of the telegraph will make clear those governing the others.

All the systems are alike in consisting of an alternating current source, sending a high frequency wave motion through the ether to a sensitive receiving station. The Marconi plant at Glace Bay, Nova Scotia, which communicates with Clifden, Ireland, has as a current supply a 350-kilowatt, 3-phase alternator generating at 2,000 volts. The current is transformed to a high voltage by means of an oscillator or induction coil and transformer. This rapidly surging current passing through an aerial wire or antenna sends out Hertzian waves in all directions at a velocity of 186,400 miles per second. The first installations employed a vertical wire from which the waves were propagated equally in all directions, but it was subsequently found that with an inclined wire the strongest transmission is in the direction of the lower end of the wire. At the Glace Bay system there are fifty aerial wires run from the top of towers 265 feet high nearly horizontal for several hundred feet to the operating stations. Smaller stations employ the intermittent spark discharge of a condenser, batteries and spark coil, or a vibrating electric arc. This latter adaptation of the Duddell "singing arc" is being employed by Poulsen to obtain undamped oscillations, the first named methods giving short trains of waves following one another at comparatively long intervals, each commencing strongly and dying out quickly in amplitude.

It is in the receiving apparatus that we find the greatest variation in design to fulfill the function of detecting and indicating the waves. This was first accomplished by coherers, whose resistance was changed by the action of the current received. This was employed by the Telefunken Company, and the Lodge-Muirhead systems, having been discarded by Marconi for the magnetic detector, in which the conditions of a magnetized iron wire are altered. Fessenden employs a barreter or electrolytic detector, whose polarization is altered by the waves. Others have used variations in thermo-electricity, electro magnetism and current rectifiers as detectors. As a rule, the "clicks" are indicated by a telephone, which cannot be used without intermediate apparatus because of its great inductance. One of the most successful of recently invented detectors is the De Forest "audion," which consists of an incandescent filament in a vacuum, shunted by a circuit containing a battery and telephone receiver. The Hertzian waves cause variations in the current through this circuit, which are made manifest by the telephone receiver as clicks of longer or shorter duration.

Having perfected instruments that would "work," there remained three problems to be solved: how far, how fast, and how secret. As to distance communication is regularly maintained across the Atlantic, and we on the Pacific have read Sitka at San Diego. The speed is being increased rapidly, but is yet much less than that now attained with wires. No practical method of absolute secrecy beyond the use of codes has yet been devised. Interference between neighboring stations is avoided by close turning to receive only specified wave lengths. A wave length of 400 meters is often used for short distances, while one of the trans-ocean stations employs waves 4,300 meters long. The International Convention recommended that wave lengths from 600 to 1,600 meters be reserved for naval purposes. With recently devised apparatus it is possible to tell not only the direction from which a message has come, but also the distance.

The progress already made in wireless telegraphy but presages that to be made in telephony. The United States Navy has installed twenty-eight sets of wireless telephones on the vessels now making the trip from the Atlantic to the Pacific, and the latest reports state that all orders between the vessels of the fleet are being satisfactorily transmitted by this means. From the preceding description of the action of the wireless telegraph we can readily comprehend that of the radio-telephone. Through the medium of a microphone transmitter sound waves correspondingly vary the amplitude of the Hertzian oscillations produced by an alcohol flame shunted across the terminals of a direct current generator, in series with which are an inductance and capacity. In the De Forest system these are received by the "audion," while the systems of Preece, Ruhmer, Arco, Poulsen and others employ different devices. All wireless telegraph stations employing a telephone in the detector can receive but not transmit the telephonic messages. The service is guaranteed for five miles, but is credited with a range of thirty. While the wireless telegraph requires an experienced operator both for transmitting and transcribing messages, the telephone may be used by anyone. Recent experiments indicate that the sound alters both the strength and the period of the oscillation, the reproduced telephonic signals being caused by the variations in the received energy. This is the most serious disadvantage of the system, for the actual energy received is necessarily small in amount. This, together with present lack of permanent record and limitation to an experimental distance of less than three hundred miles, does not give promises of great success for Poulsen's trans-Atlantic attempt in February.

The nearest approach to Tesla's ten-year-old dream of wireless power transmission is yet limited to wireless control of mechanism at a distance. By its means lamps may be lighted, motors started, or bells rung. Press dispatches state that photographs have also been transmitted in this way, but in every case there must be ample power at the receiving end. It may be directed, but it has not been transmitted. But even as the modern scientist is making real the old alchemists' dream of the transmutation of metals, so may he embody this chimera of wireless power transmission.

Discounting the future of these possibilities, certain irresponsible brokers are selling stock in heavily over-capitalized holding companies to unsophisticated innocents. Quoting from such a prospectus: "Owing to the rapidly growing recognition of the superior value of the shares of this company, the price is subject to sudden increase, and subscriptions are invited only on the distant understanding that the price is subject to momentary advance upon telegraphic advices." Anticipated earnings of 150 per cent per annum are luridly presented partly on the supposition that an uncompleted trans-Pacific service will earn nearly one million dollars annually. By unauthorized association with names of those of known probity, the lure is attractively baited. In their estimation it will be but a short time before all telegraph and cable companies will be scrapped, and the price of copper wire fall even below its present level. The sooner this really worthy system is taken from the clutches of these vampires of low promotion and high finance, the faster will it progress along legitimate channels. Wireless transmission has too much vitality to long languish in such debasing surroundings.

PERSONAL.

Stephen A. Hoag is assistant superintendent of the Seattle-Tacoma Power Co., at Seattle, Wash.

The annual meeting of the Illuminating Engineering Society was held on Friday, January 10, 1908, in the rooms of the Electrical Club, 14 Park Place, New York City, at 8:15 p. m.

Leopold Stocker, master signal electrician, U. S. Army, is in San Francisco in connection with the fire-control installation now being established by the Signal Corps in the artillery district of San Francisco.

David F. Atkins has charge of the inspection of heating, hoisting, ventilating apparatus, electrical, and plumbing work installed in the Federal buildings in San Francisco, as well as the preparation of specifications for necessary repairs.

BOOKS RECEIVED.

Volume 30, No. 1, "Proceedings of the American Society of Mechanical Engineers," is of particular value to those interested in train lighting, as it contains a paper on this subject by Mr. R. M. Dixon. Mr. Henry Hess contributes a paper on "A Journal Friction Measuring Machine." In addition to contributed discussion on papers previously published this volume contains the Year Book for 1907.

"Electrocraft Illustrated List of Approved Electrical Fittings and Revised National Electric Code" contains a list of fittings that have been examined and approved by the Underwriters National Electric Association. This is a second edition of this useful list, which is to appear quarterly hereafter. It is from the Electrocraft Publishing Company, of Detroit, Mich., and sells for fifty cents.

The National Electric Light Association sends the proceedings of its Thirtieth Convention, held at Washington, D. C., June 4, 5, 6, 7, 1907. These two volumes contain a great amount of interesting and valuable information on the commercial development and management of central stations, as well as technical papers on recent progress in the development of power apparatus and applications. This information is both practical and technical, and illustrates the advantages of membership in the Association.

"Proceedings of the American Institute of Electrical Engineers" for January, 1908, besides the usual notes and comments, contain the following papers: "An Exhaust Steam Turbine Plant," by Henry H. Wait; "A New CO_2 Recorder," by C. O. Mailloux; "Discussion at Niagara Falls Convention, June 27-28, 1907"; "Practical Aspects of Steam Railroad Electrification," by W. N. Smith; "A Single-Phase Railway Motor," by E. F. Alexanderson; "The New Haven System of Single-Phase Distribution with Special Reference to Sectionalization," by W. S. Murray; "The Best Engineering Education," by Charles F. Scott; "Electrical Engineering Education," by Charles P. Steinmetz.

TRADE NOTES.

The Foos Gas Engine Company operate the largest plant devoted exclusively to gas engine manufacture, and their business is being extended very rapidly.

The Foos Gas Engine Company, of Springfield, Ohio, have purchased the business of the Marinette Gas Engine Company, which comprises the line of Walrath multiple-cylinder engines for electric and power work, from 20 to 500 horsepower.

D. P. Dyer, United States District Judge, has reduced the award of Henry H. Denison, special master in the patent infringement suit of the Westinghouse Electric and Manufacturing Company against the Wagner Electric Manufacturing Company, from $132,433.35 to $1 and costs. The suit was filed in 1902, and charged an infringement of patent. The Wagner Company admitted there had been a slight infringement of the patent, but asserted that it was only a small part of the entire apparatus.

TRADE CATALOGUES.

A beautifully illustrated and printed book from the Allis-Chalmers Company describes the Keewatin Flour Mills and other notable plants equipped by this company.

Murray Iron Works Co., of Burlington, Iowa, sends a unique illustrated catalogue giving the Nomenclature of Murray Corliss Engines, showing all the parts in detail and assembly, and giving their names.

The Westinghouse Machine Company of Pittsburg, Pa., send an interesting illustrated description of the Westinghouse Storage Battery Auto-Truck for Industrial Railways, which satisfactorily solve the problem of the economical moving of material about large works.

The Thirty-eighth Annual Catalogue of the Worcester Polytechnic Institute, of Worcester, Mass., indicates the thoroughness of the courses given. The register of graduates shows that 1,201 men have completed courses.

"Public Service," from the Portland Railway, Light and Power Co., is, as usual, filled with helpful hints for the power user. The cover illustration shows the interior of the new generating station at Cazedero, Oregon. Local applications of electric drive for machine and printing offices are illustrated, and a number of attractive lighting and heating installations portrayed.

The California Electrical Works of San Francisco, Pacific Coast agents for the Western Electric Company, announce that their new telephone catalog, covering Standard Bell Telephone Apparatus and Telephone Supplies of all descriptions, will be ready for distribution the first week in January. They are also receiving proof for a large and handsome General Supply catalog. Persons wishing copies of either or both the above should write for them immediately.

MEETING NOTICE.

The San Francisco Section of the American Institute of Electrical Engineers has been reorganized, with a new directive board formed, consisting of A. M. Hunt, chairman, F. G. Baum, W. W. Briggs, Paul Downing, and Geo. R. Murphy, secretary. The first meeting will be held Friday, January 24, in the basement of the California Gas & Electric Corporation Building, corner Franklin and Ellis Streets, San Francisco, at 8 p. m. An informal dinner for old members will be held at 6:30 o'clock, at the Old Poodle Dog Restaurant.

The next meeting of the New England section of the Illuminating Engineering Society is the annual meeting at which officers for the ensuing year will be elected in accordance with notice already sent out. The meeting will be held at 8:00 p. m., Tuesday, January 14, 1908, in the Edison Building, 39 Boylston Street, Boston, in the Assembly Hall, on the seventh floor, instead of as usual on the third floor. A paper entitled, "Effects of Light upon the Eye," by Dr. H. H. Seabrook, of New York, will be read by the author.

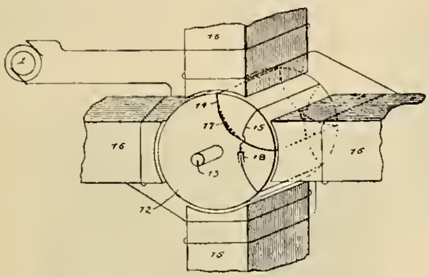
PERSONAL.

H. F. Froesch has located in San Francisco, as the representative of the Federal Electric Sign Co., of Chicago. He was in the light and power department of the Chicago Edison Company for fifteen years.

PATENTS

ELECTRIC MOTOR. 875,178. Dugald C. Jackson, Madison, Wis.

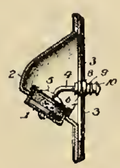
In an induction motive device, the combination with means for creating a single phase alternating field, of an armature subjected to the action of single phase alternat



ing field provided with a plurality of electric circuits, and phase modifying means to enable the armature to start from a state of rest associated with circuits for the purpose of creating out of phase currents in armature.

TELEPHONE-TRANSMITTER. 875,138. Christian Umbach, New York, N. Y., assignor to Western Electric Company, Chicago, Ill.

In a telephone transmitter, a button provided with a movable electrode having an angular stud projecting therefrom, a diaphragm, means for supporting button, and



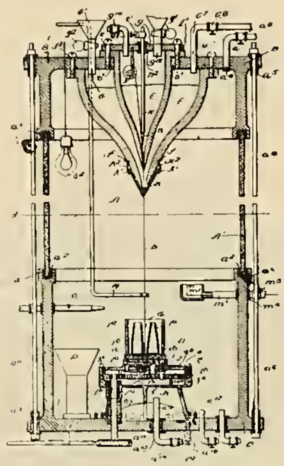
diaphragm in angular relation to each other, diaphragm having an opening through which stud projects, and means for securing diaphragm to stud, means being self-adjusting to adapt itself to the angle at which the stud and diaphragm are assembled.

INCANDESCENT ELECTRIC LAMP. 874,977. Chas. L. R. E. Menges, The Hague, Netherlands.

The process of producing incandescent conductors or filaments for electric lamps, consisting in intimately mixing a material having electric conductivity with a non-conducting substance, by producing in the shape of the incandescent conductor, a mixture of the non-conducting substance, carbon, and an oxygen compound of a metal and heating said mixture by an electric current until the carbon by its combination with the oxygen of the named compound parts in the gaseous state, leaving the metallic material in the filament.

MACHINE AND APPARATUS FOR MANUFACTURING FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS. 874,938. Francis M. F. Cazin, Hoboken, N. J.

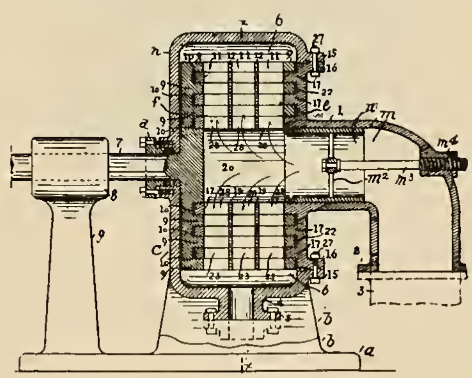
In an apparatus of the character stated, an exhaustible vessel, a plurality of receptacles having concentrically arranged squirting mouths, receptacles adapted to receive



semi-plastic material, means for maintaining such material in the semi-plastic liquid condition and for forcing such material out of the squirting mouths in the receptacles, receptacles having their squirting mouths arranged to discharge into exhaustible vessel and means for simultaneously forming such squirted fillet into the final shape desired.

TURBINE. 875,131. Byron Stevens, Oakland, Cal. Filed September 7, 1907.

In a turbine motor, the combination of a tubular casing, a shaft entering the same on one side, a rotatable disk in the casing on the end of the shaft close to one wall thereof having a series of concentric tubes provided with openings or blades on the inner face of disk, a second series of concentric tubes with openings or blades connected to



the opposite wall of the casing, the inner tube of which incloses a chamber extending to the face of disk on one end and communicating at the opposite end with an intake or supply pipe, a slide valve in pipe, with a peripheral space of the casing surrounding tubes provided with an exhaust pipe.

INDUSTRIAL

TUNGSTEN SERIES INCANDESCENT LAMPS.

The city of Grosse Point, Michigan, has recently installed a series tungsten incandescent street lighting system where the advantages of this kind of lighting are well exemplified. The station equipment consists of two 8.8-kilowatt, 5½-ampere constant-current transformers. One of these is held in reserve, while the other supplies current to seventy-seven 60-candlepower General Electric tungsten series incandescent lamps, suspended from artistic iron poles. All wiring is laid in conduits to the poles and wires pass up the center of the pole to the lamps. The form of poles used not only gives a very substantial line construction, but makes a much more artistic appearance than the usual wooden pole. These poles and lamps are shown in Figs. I and II.

FIG. 1.

FIG. 2.

One of the interesting features of this system is the radial reflector with which the lamps are equipped. This form of reflector, which was recently developed by the General Electric Company, is so constructed that the light is spread and projected very evenly over considerable area, instead of being nearly all concentrated in a circle around the lamp. Fig. III shows the candlepower distribution of a 40-candlepower series tungsten lamp, equipped with a radial reflector. Fig. IV shows one of these reflectors on a lamp. It may be seen from the diagram of the candlepower distribution that at about 30 degrees below horizontal the effective illumination is 50 candlepower, making the efficiency at this point about 1 watt per candlepower.

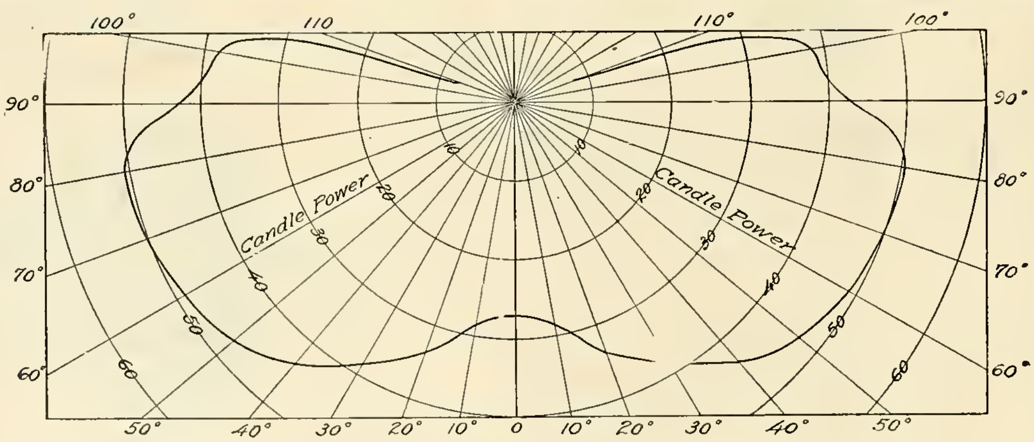


FIG. 3.

The series sockets with which these lamps are provided are so constructed that when a lamp is removed from the socket, two contact plates of large area close together before the lamp is quite drawn out of the socket, leaving no danger of an open circuit at any time.

Tungsten series lamps are made in 32, 40 and 60-candlepower sizes, with current ratings of 4, 5.5, 6.6 and 7.5 amperes, and are exceedingly hardy on account of the heavy short filament. They will burn for nearly 1,000 hours at efficiency of from 1¼ to 1½ watts per candlepower.

Another installation of series tungsten lamps for street lighting has recently been made in Grand Rapids, Michigan. The lamps are of 60 candlepower, and were placed on one of the principal streets of the city. Judging from the complimentary remarks of the press and the City Council, the test installation has proved highly satisfactory.

FIG. 4.

The tungsten lamp, with its high efficiency, should greatly increase the use of series incandescent lights in suburban and residential districts where the thick foliage makes it necessary to have the units distributed at short intervals to produce satisfactory illumination.

Allis-Chalmers Company's bulletin No. 2027, entitled "The Hydro-Electric Plant at Trinity River, California," contains information of an interesting power transmission system. This plant is in the central part of Trinity County, Cal., two miles below the town of Junction City, where Canyon Creek, from which the water used for power is obtained, flows into the Trinity River, having a drainage area of fifty-two square miles. The dam, which is small, serves merely for diverting the water. Alternating sections of ditch and open flumes, with a total length of 5,250 feet and a tunnel 1,821 feet long, are comprised in the system. An effective head of 600 feet, or working pressure of 260 pounds per square inch, is obtained from two penstocks, each 1,165 feet long. This power house is equipped with Allis-Chalmers electrical machinery, consisting of two three-phase, 25 cycle generators, each 750 kilowatts, 500 revolutions per minute. 2,200 volts, seven step-up transformers and auxiliary apparatus.

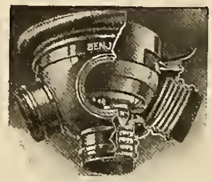
DIRECT CURRENT SPARKING.

Direct current dynamos spark less with carbon than with copper brushes when working with variable load and consequent shifting of ideal brush position. Carbon has a higher contact resistance, checking sparking currents, and preventing short circuiting, and less friction, allowing smaller commutator wear.

Electrical engineers in the employ of E. H. Harrison, Julius Kruttschnitt, and E. E. Calvin have finished a preliminary report on the proposed electrizing of the Sierra Nevada Mountain division of the Southern Pacific main line to Ogden and Omaha.

INDUSTRIAL.

The new Benjamin separable wireless cluster, as shown in the accompanying illustration, consists of two principal parts, separably connected, making it possible to attach or remove body portion without disturbing the wiring connections. With this cluster the supporting base, together with insulating base carrying binding screws, may be installed while construction work is under way, and the body portion can be instantly attached at any time when the building is completed, by means of the bayonet snap lock. As the binding screws are accessible from the front, slack wire is unnecessary.



Receptacles mounted on the body portion, form short sockets with which any standard shade-holder may be used. The supporting base is small enough in diameter to pass through any ordinary reflector with 3¼-inch fitter, and glassware may be installed or removed without disturbing wiring connections.

Only two forms of insulating base are necessary to cover the entire range of lights: the first will take any number in the circle, from two to six (type 5); the second, any number with additional center light from three to seven (type 5K). To proceed with an installation requiring clusters for different numbers of lights, it is necessary only to have in stock the correct number of either type, i. e., since only two forms of bases are required, regardless of the number of lights in question, the proper bases may be installed from

among the clusters at hand, and the body portions having the requisite number of lamp openings transferred from other clusters procured later on. Clusters with center-lamp openings are furnished with three binding posts, whereby center lamp may be operated independent of the side lights. This three-wire connection may be changed to a two-wire, by merely extending one of the wires to the additional binding screw.

The Benjamin Separable Wireless Cluster is light in weight, compact in structure, and neat in appearance. There are no porcelain parts visible, and the finish can be made to conform to any requirements. It is especially adapted as a center piece for spread-electric or combination fixtures.

NEWS NOTES

OIL.

San Francisco.—Figures published by the oil exchange show that with the year just closed $12,511,646.58 has been paid in dividends by the listed oil companies of the State.

Vallejo.—It is reported that the Standard Oil Company is preparing to locate an auxiliary oil supply station on the water front of this city, which will be used in supplying oil for use on the Mare Island yard.

San Francisco.—The Independent Oil Company has been granted a permit to lay an iron pipe in Potrero Avenue, Fifteenth and Utah Streets, to be used for the conveyance of crude oil from tank cars to storage tanks.

Bakersfield.—The Producers' Sales Agency has authorized President St. Clair and other officers to make all necessary arrangements to construct an oil pipe line to the railroads, build loading tracks, provide for the storage at San Francisco Bay, secure contracts, and do all other things necessary.

San Francisco.—Contracts have been signed by the Standard Oil Company for the purchase of high grade oil in the Santa Maria fields at eighty-five cents a barrel. This is a record price and will prove an impetus to development in all the petroleum regions of the State. The last contracts made in the Santa Maria fields were on a fifty cent basis.

Bridgeport.—Advices from Mono Lake state that the oil boom is now on. Preparations for boring are being made, but so far no actual work has been done. It appears that the island is the bone of contention at the present time and a lawsuit may result. One set of locators has possession of the island and refuses to allow others to go on the ground to work. The island is located three and four claims deep.

Santa Maria.—Reports from the Santa Maria Oil Fields state that the production of the field at present ranges from 800,000 to 900,000 barrels a month, of which fully ninety per cent is piped to Port Harford. The Union Oil Company of California is turning out sixty per cent of the total amount and is the most successful operator in the field. The Standard has practically no control over this field on account of the water transportation, and is receiving only about 155,000 barrels a month.

Los Angeles.—Advices from Bakersfield state that the Standard Oil Company has raised the purchasing price of all oil to forty cents a barrel, regardless of contract price, whether thirty or nineteen cents a barrel. The Associated is reported to have met this price. The first rumor concerned only the Midway 3,500,000 barrel contract. The Midway contract was made by the Mascot Oil Company, other Midway producers participating, and a thirty cent price was fixed, the Standard carrying a pipe line into the field and receiving oil. The increase to forty cents is considered a victory for the independents in their fight for higher prices. All companies of the agency are pumping oil, but are running it into tanks. A minimum of seventy-five cents is their aim, and they are determined to market their own product.

ILLUMINATION.

Redwood City.—The Board of Supervisors has granted W. J. Martin a franchise to maintain an electric light plant in First Township for lighting and heating purposes.

Glendora.—Mr. Gauslein, of the Southern California Gas Company, states that all arrangements are completed for the erection of a gas plant and the installation of a gas system at Glendora.

Corona.—The Corona Gas & Electric Light Company will build a line seven miles in length to the Pedley power-house, which will be capable of transmitting 17,000 volts of the electric current to its plant in this city.

Imperial.—At a special session of the City Trustees a resolution was passed for the placing of electric lights on the streets. It is understood that the contract for lighting the city will go to the Holton Power Company.

Ocean Park.—The Seaboard Construction Company has presented to the Ocean Park Board of Trustees a plan for providing a city gas and electric lighting plant. The plan will receive the attention of the board at its next regular meeting.

Hermosa.—At a recent meeting of the City Council a communication was read from the Watson Construction Company stating that for $24,000 they would install a gas plant in Hermosa, including seven miles of mains, with a capacity of 120,000 cubic feet per day.

Tucson, Ariz.—E. B. Reeser, secretary and treasurer of the Mineral Hill Consolidated Mining Company, has returned from Pittsburg, and states that his company has arranged for the necessary capital to erect an electric light plant. The order will be placed in Denver and the plant will be delivered as soon as possible.

Silver City, N. M.—The New Mexico Light, Heat & Power Company is installing several new pieces of machinery, including a 1000-kilowatt alternating generator, having a capacity of 2,200 volts. The present building will be enlarged so as to have all the machinery under one roof. The improvement to the plant will necessitate the complete reconstruction of poles and wires.

Eureka.—All of the stock of the Eureka Lighting Company has been transferred to the Humboldt Gas & Electric Company, which will eventually absorb both lighting companies of this city. There are now three lighting companies in Eureka—The Eureka Lighting Company, the Humboldt Gas & Electric Company and the North Mountain Power Company. All of the companies are now controlled by the people interested in the North Mountain Power Company.

Oakland.—The lower part of Broadway, between First and Seventh Streets, is to be lighted with thirty-six electroliers within the next six months. A resolution was introduced at the City Council by which it was agreed the city would pay the expense of lighting the electroliers, which are to be put in place by the merchants. Merchants on the lower part of Broadway will ask for better lighting facilities. An effort will be made to obtain a heavier voltage than is allowed for the lamps in the upper part of the city. The electroliers on Twelfth Street are said to be defectively wired. Several efforts to repair the defects have been made, but without success.

TRANSPORTATION.

San Francisco.—John E. West has been acquitted of the felony charge of having interfered with the trolley wires of the United Railroads on September 20th last.

Los Angeles.—The Los Angeles-Pacific Railway Company has started work on a line to Toluca from Santa Monica Avenue. It is said an effort is being made to beat the Huntington lines into the San Fernando field.

Azusa, Cal.—The City Trustees have adopted the ordinances granting to the Los Angeles Interurban Railway Company the privilege of constructing a spur track over public streets and over private property in Azusa.

Phoenix, Ariz.—Harry J. Bennett, one of the promoters of the proposed electric line between Phoenix and Mesa, states that the project would include the building of a bridge across Salt River. Gasoline motors may be used instead of electricity.

San Francisco.—The application of G. B. Willcutt for the United Railroads for a cross-town street-car-line franchise via Scott, Duboce and other streets was rejected by the public utilities committee of the Supervisors on the ground that the Board should not issue franchises to third parties.

San Francisco.—The retiring Board of Supervisors decided that it would be inadvisable to experiment with a municipal street railroad at the present time, and the $720,000 provided for the acquisition of the Geary Street line will accordingly be devoted to the improvement of streets and sewers and the rehabilitation of public buildings.

Berkeley.—The San Francisco, Oakland & San Jose Railroad Company, known as the Key Route Company, has filed an application with the Trustees for a franchise along Sacramento Street from the south to the north town line, tapping the northwestern district of Berkeley and running to the proposed State Capitol site. The application asks a right of way for fifty years. The company asks for a permit to construct a single or double track electric road and will begin work six months after the ordinance is granted and operate trains within two years.

Pasadena.—The residents of North Pasadena, who have been working for an electric line, have determined to build the road without bonds and without the co-operation of the railroad companies. The line is to run along Lincoln and Piedmont from the Pacific Electric line to the mouth of Millard Canyon. The money needed, $84,000, will be raised by property owners along the line. They will not only build the line and buy cars, but will build a power plant on the government reserve in the mountains. A. J. Toolen, of North Pasadena, is at the head of the movement.

TRANSMISSION.

Los Angeles.—Machinery is being installed on Cottonwood Creek for the power plant to be used in dredging the Owens River, which will be ready by May 1st. The plant will have 1200 horse-power.

Oroville.—The Great Western Power Company, which is constructing a large power plant in the Feather River Canyon, a few miles above Oroville, promises that power will be furnished by the company in October. The total cost of the plant will be $6,000,000. Its total capacity when completed will be 100,000 horse-power. The Feather River is being diverted through a tunnel built at Horseshoe Bend. Indications point to the fact that the company will furnish the power for electrifying the Western Pacific over the mountains.

Salt Lake City.—The Utah Light & Railway Company will begin the work of erecting a $300,000 power plant at Devil's Gate, eighteen miles east of Ogden, early in the spring. The plant will have a capacity of 2000 horse-power. The plant is necessary on account of the increased demand of the company for electric power. The site was purchased jointly by the Utah Light & Railway Company and the Utah Construction Company about four years ago. Some work has already been done on the plant, but active work will not begin until spring.

Goldfield.—General Manager Poole, of the Nevada-California Power Company, which has its generating plant at Bishop, Cal., says that the electricians will be paid $6 per day after January 10th, but that the Brotherhood of Electricians will not be recognized. The employers state that hereafter the open shop will prevail in this district, but that there will be no discrimination against union men. The scale of $6 a day is $1 higher than that formerly proposed. The members of the union say they are willing to accept the reduction, but object to the open shop. A walkout of electricians is imminent.

FINANCIAL.

Porterville.—The waterworks bonds amounting to $50,000 were carried at the election last week.

Roswell, N. M.—The City Council has passed corrective ordinances placing the bond elections for water works, sewer, ditch and fire department improvements to the amount of $165,000, on February 20th.

San Francisco.—According to the report of A. H. Payson, president of the Spring Valley Water Company, submitted to the stockholders at their annual meeting, the corporation faces a deficit of $73,156.23 as a result of the year's operations. This is ascribed to the large expenditure of $347,850.84 for replacement and equipment of sections of the plant destroyed by the big fire. Had the company secured the $160,000 which it endeavored to obtain from the city, the deficit would have been turned into a surplus. The president's report paints a dark picture for the future, with suggestions of a water famine. The report gives approximate figures as to the company's outgo and income during the last year. Water sales brought in $1,870,560.03; other revenues were $54,189.34. There were $97,754.07 delinquencies on the 1906 collections, making the total revenues $1,772,806.24. The 1907 delinquencies, $72,247.71, have been carried forward. The expenses were: Normal, $604,278.58; abnormal, due to replacement and equipment since the fire, $347,850.84; taxes paid and accrued, $301,830.10; coupon interest, $718,440; total, $1,972,399.52; deficit, $73,156.23. A gratifying increase in business is reported. December 31, 1905, there were 53,113 rate payers; after April 18, 1906, 29,931; December 31, 1906, 37,538; December 31, 1907, 47,293. The number of small consumers is larger than before. On December 30, 1905, there were 4,743 bills of $1 or under, while on the same date in 1907 there were 8,367. The following directors were elected: A. H. Payson, president; J. M. Quay, Homer S King, I. W. Hellman, Jr., W. B. Bourn, J. Henry Meyer and F. B. Anderson. Of the 280,000 shares of the company, 179,755 were represented at the meeting.

TELEPHONE AND TELEGRAPH.

Honolulu.—It is reported here that the Matson Navigation Company will install a wireless station on this island for its ships, and that some of the Planters' line of ten sailing vessels, reported sold to the Matson people, will be equipped with wireless.

Helena.—It is probable that the strike of employes of the Rocky Mountain Bell Telephone Company in the States of Utah, Wyoming and Montana will be amicably settled. At a conference between the affected interests all matters were agreed upon, save the demand of the unions that the injunction secured in the Federal Court here restraining interference with the business and property of the company be dismissed.

Yreka.—Hessig Bros. have just completed the extension of their telephone line from Oak Bar to Hamburg Bar. Their intention was to complete it this winter, but owing to the bad weather it was thought advisable to delay the work. The old line from Yreka to Happy Camp has been purchased by them, and they will use it until they complete the new line. It is also their intention to run a line into Scott Bar, so that when the work is completed all of the towns in the county will have direct telephone communication.

Vallejo.—Operator Millison of the navy, who is deemed an expert in long distance wireless telegraphic communication, has just established a coast record. In charge of the new station recently established at Sitka, Alaska, he has succeeded in establishing connection with Mare Island station and the station at Point Loma, the extreme southern point of the California coast. During the last week he succeeded in exchanging messages with all the vessels of the navy along the coast equipped with wireless apparatus.

TRANSMISSION.

Red Bluff, Cal.—A notice of the appropriation of 10,000 inches of water in Thomas Creek has been filed by J. H. Howell, of Henleyville.

Oakland.—The engineers of the Great Western Power Company, which acquired property on Brooklyn Basin, south of Fifth Avenue, in East Oakland, are now at work with the intention of constructing a large power plant there.

Nevada City, Cal.—The Telluride Power Company has recently located water rights in Mono County and will establish plants to supply Nevada mining camps with electricity. The company already has one plant in operation near Bridgeport.

Sacramento.—F. E. Fitzpatrick has resigned his position as superintendent, at Sacramento, Cal., of the California Gas & Electric Corporation. His time is now entirely occupied with his work as general manager of the John Martin interests.

Williams, Ariz.—Civil Engineer Park Latimer is at Lee's Ferry, 150 miles up the Colorado River from Bass' camp in the canyon, to make a preliminary survey of water locations for a French syndicate. A power project to furnish power to surrounding mines will be carried through if the survey proves the scheme to be practicable.

Fresno.—The Kings River Power Company of Los Angeles has given notice of the appropriation of 25,000 inches of water from the Kings River to propel machinery for the generation of electric power at the power-house to be located on section 25-12-28, and to be transmitted to Fresno, San Francisco and Los Angeles.

CLASSIFIED LIST OF ADVERTISERS

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XX. SAN FRANCISCO, CAL., JANUARY 25, 1908 No. 4

A UNIQUE ELECTRIC RENOVATOR.

The accompanying illustration shows a novel and interesting electrically-operated labor-saving device for use in the home. It is a portable renovating and cleaning machine which can be easily handled without as much effort as a carpet sweeper, the passing of the device over the carpet once cleans it thoroughly.

In a single operation it picks up paper, matches and other coarse material, without having to resort to the broom and dust pan, and at the same time removes every particle of dust and dirt, leaving the carpet looking as fresh and clean as when new.

There are three attachments provided with this electric renovator, one of which is used for cleaning cushions, mattresses and lounges, and another for all crevices, corners and close places from the floor to the ceiling. There is a third for cleaning the walls, pictures, curtains, and mouldings, as well as the shelves, cornices, and decorations and ornaments.

It is maintained that by keeping the dust from the lace curtains and other hangings, they not only always look clean and fresh, but they require less laundry work, and therefore last much longer.

ELECTRIC SWEEPER.

This electric renovating machine can be connected to any electric light fixture, for domestic work of office or hotel, and does not make it necessary to have air or vacuum cleaners on the street with long lines of hose running into the house.

There is a powerful electric motor of small dimensions attached to the renovator, which causes a brush to revolve with great rapidity, and this brush being adjusted to suit the carpet being cleaned, loosens every particle of dust, which is drawn into the renovator by a double fan, the latter connected direct to the motor, and producing a great volume of air. There is no dust stirred up, to settle elsewhere in the room, as all of the dirt is immediately discharged into a separator, shown in the illustration. This separator is of ample capacity, and is easily removed, so that all dust and dirt may be burned or disposed of in any other way.

Just back of the revolving brush there is a drawer for paper and matches and the like to be removed, while the fans are located at the side of the electric motor with the dust collector at the top. The house connections for the attachments, as well as the air valve closing and opening intakes, are between motor and fans and the revolving brush, while the pipe at the bottom of the separator at the top is so arranged that the hose can be connected to aerate and sterilize. As often as desired, the thorough renovating of the feathers in pillows can be done in a few minutes by drawing all of the dust from them and then driving a volume of air through them, in this manner every feather being thoroughly separated.

All passenger and freight trains through the 2¾-mile Cascade tunnel of the Great Northern Railway are to be hauled by 100-ton, three-phase General Electric locomotives. Each locomotive will be equipped with four 325-horsepower induction motors, and will be capable of hauling a 500-ton train at 15 miles per hour up a 2% grade, the tunnel grade being 1.6% east. The speed down grade is to be controlled by regeneration with reversible motors, doing away with overheated tires and brake-shoes. As the tunnel is without ventilating shaft, poisonous gases and sooty, slippery tracks have interfered with steam locomotives. Power is to be transmitted at thirty-three thousand volts from the generating plant on the Wenatchee River, 30 miles to the step-down transformer station at the mouth of the tunnel. Current will be furnished by two 2,000-kilowatt, three-phase, water-wheel-driven generators, operating at 25 cycles. Dr. C. T. Hutchinson is supervising the installation, which is expected to be in operation within a year.

Transformer plants are now equipped with a fire extinguisher that will send a stream of carbon dioxide into any transformer case. Means are provided for quickly emptying the oil into the tail race.

Thirteen practical lectures in electrical engineering, by prominent electrical engineers of the Pacific Northwest, have been planned by the electrical engineering department at the University of Washington for the students in the engineering courses and for practical electricians of Seattle and nearby places. The lectures began December 11, and will be held at 8 p. m. in room 3 of Science Hall at the university. The first five lectures will be on "Telephones," by C. E. Fleager, superintendent of construction of the Pacific Telephone Company for Washington, Oregon and Idaho. The next five will be on "Central Station Practice," by James D. Ross, superintendent of the Seattle municipal light and power system. The last three will be given by John Hariberger, general superintendent of the Seattle-Tacoma Power Company, on the subject of "Electric Power Transmission."

PRACTICAL ASPECTS OF STEAM RAILROAD ELECTRIFICATION.*

By W. N. Smith.

The writer believes that in discussing this problem, the matter of the particular electric system to be employed should not necessarily be placed foremost, but that practical railroad operating conditions must be regarded as of paramount importance. Getting a larger perspective upon the activities of the railroad as a whole, rather than keeping our attention focused upon the purely electrical part of it.

The fields of activity concerned in the electrification of a steam road may be subdivided into two broad divisions.

1. The electrification project, as it calls for the services of the manufacturer and the engineer.

2. Railroad operation, which in this connection may be considered as three fold:

(a.) Financial or economic,
(b.) Railroad construction or standardization, and
(c.) Transportation or operative.

Reviewing these divisions, the electric railway industry occupies a peculiar position as compared with the general trade in railway appliances.

A practical monopoly of electric propulsion apparatus is divided among a very few large companies. This is somewhat similar to the general situation as regards steel rails, and steam locomotives, both of which commodities are produced by a relatively small number of manufacturers. Until recently the steel-rail situation was kept very close to a uniform standard in quality of product, as well as in price, but there having been a strong protest by the railroads against the defects that have been developed in quality, this feature is now undergoing revision by the steel companies. With respect to locomotives, however, more liberty of action is preserved by the railroad companies. The requirements of the motive-power departments of different railroads are so diverse as to afford little opportunity for wholesale standardization, which is a matter that is left entirely in the hands of the railroad customers rather than with the manufacturers. There are certain tendencies toward standardization on a large scale, such as that made possible by the associated Southern Pacific, Union Pacific, and allied lines east and west of the Mississippi, for the sake of securing economy in maintenance and operation; but such attempts as have been made toward standardization on the part of the locomotive manufacturers seem to have pertained more to certain interchangeable parts of the locomotives, than to types which have usually been developed by the needs of individual roads. With electrical motive power apparatus, however, the art is relatively much newer, and the number of trained specialists is fewer, and mostly concentrated at the manufacturers' shops so that the opportunity afforded the manufacturers to inspire and direct the formation of their customers' ideas on electric propulsion has not been neglected. It has had a great effect upon the development of the industry.

By the time that twenty or thirty roads have electrified their lines, wholly or in part, the attitude of their operating and maintenance engineering forces may become an important factor in the situation; and the commercial rivalry now shown in devising and perpetuating electric systems will then be diverted from its present tendencies, toward the more natural function of competing to furnish apparatus as specified by the railroads.

The consulting engineer's standpoint at the present time is that of an interpreter between the manufacturer and the railroad. He has to translate the limitations of the electrical

*Condensed from a paper presented at a meeting of the Ithaca Section of the American Institute of Electrical Engineers, Ithaca, N. Y., Dec. 6, 1907.

apparatus in terms easily understood by railroad officials, who generally do not pretend to be electrical experts; and he must be sufficiently familiar with railroad standards and practice to insist that the electrical manufacturer shows due regard for the general fitness of his apparatus to railroad purposes, both in design and reliability. He is frequently charged with a very grave responsibility in aiding the railroads to decide some very fundamental and perplexing question arising from the relationship between the old art and the new.

The standpoint of the railroad management as above suggested comes under three general heads; the financial or economic, the constructive and maintenance, and transportation.

The control of a railroad being in the hands of those who represent the investors, the financial aspect of any improvement is the first to receive consideration. The financier looks upon the problem of railroad motive power as only one of a large number to be solved from the standpoint of the maximum possible return for every dollar invested, whether it be for the purpose of reducing the cost of conducting the existing business, or of largely increasing that business. A project for the electrification of a railroad is usually attractive, because of the increased amount of traffic it becomes possible to handle in proportion to the expense of handling it. This is usually directly accomplished by increasing the speed of revenue train-movement over a given piece of track, and by reducing the amount of non-revenue train-movement.

Such questions are, of course, most pressing where conditions of traffic congestion are most severe; and for that reason most of the heavy railroad electrification has hitherto been worked out in and near New York City, where the maximum movement of passenger trains is required in the minimum amount of area available for terminal facilities.

The more general cases, however, are not likely to be regarded by the financier in quite the same light, although it is believed that they can be more convincingly solved on their financial merits alone than is possible in the case of expensive metropolitan terminals. Each case that is brought up for solution must, through careful detailed estimates, justify itself on its own merits, as affording facilities for making transportation more profitable.

When the railroad man is looking at a transportation problem from the constructive and maintenance standpoint, he has in mind the crystallized experience of some seventy years of steam railroad practice that has resulted in the development of railroad equipment along certain lines, which, generally speaking, are rather conservatively maintained. It may be well to recall the fact that the steam locomotive of the present day is in its essentials practically the same machine that was developed by George Stephenson; that is, it comprises a horizontal multi-tubular boiler with a fire-box at the rear and smoke-stack at the front, and the wheels are propelled by a direct-coupled, high-pressure engine, which increases the rate of combustion of the fuel by discharging its exhaust into the smoke-stack. Similarly, the passenger car has been developed from the old omnibus. Although the electrical equipment will necessitate, for its own maintenance, the addition of a considerable quantity of repair stock, it should not without good reason be permitted to change any previously existing standard that it is desirable to keep. On the other hand, there may be some very fundamental reasons for changing existing standards in order better to accommodate certain electrical features. An instance of this upon a certain railroad was the adoption of a new shape of splice-bar, specially rolled to accommodate a heavy rail-bond underneath it, upon a section where some new track was to be laid; while the objection of another railroad to increasing the diameter of a motor-car wheel on account of the additional size of tire that would have to be carried in stock eventually resulted in the retention of an electric motor originally adopted for a lighter car. At first the motor had been thought too small for the increased duty which was to be imposed upon it, but was found to be adequate when fitted with suitable means for increasing its capacity, thus satisfying the desire of the railroad for the maintaining of standards in its equipment, and at lower cost.

The question of clearances has often been most perplexing, particularly as regards the location of either third-rail or overhead trolley construction. The stationary features pertaining to the right of way, and the dimensions of moving equipment, must not be allowed to interfere with each other. The third-rail sometimes conflicts with bridge-gussets on the one hand, or with hopper-bottom coal-cars on the other. The use of third-rail also makes more necessary the elimination of highway grade-crossings, and requires careful attention to the protection of the public at station platforms. Low overhead bridges conflict seriously with trolley construction, particularly when high voltage is desired.

High-tension trolley construction introduces, among other problems, the purely mechanical one of providing suitable warning signs or ticklers for trainmen on the tops of freight cars; these must not only be light enough not to injure brakemen, nor damage the trolley mechanism on moving equipment, but must also be heavy enough to withstand the blows they receive from the trolley without being broken or rendered useless.

Either type of construction may require special and often expensive arrangements at drawbridges. The civil authorities in cities sometimes arbitrarily insist upon placing high-tension lines underground, which is always expensive. Telegraph and telephone lines have to be protected from mechanical and electrical interference. These are a few of the characteristic problems that arise with each electrification scheme, but solutions of them do not appear on the mathematical curve sheets with which professional papers are sometimes illustrated.

Looking again at cars and locomotives, the steam railroad man will commonly take his standard coach as the point of departure, and suggest at the outset that it be equipped electrically practically as it stands. Here it is entirely in order to remark that the main object of electrification is to facilitate traffic. The car bodies themselves should be built with that end in view, in order to get the full benefit of the superior type of power. The object to be attained affects the dimensions of the vestibules, doors, and seats, as well as the length of the car, and even the form of roof of the car may be altered from standard types without detriment to passengers, if external conditions make it desirable. Suburban service is the type of service that admits of the greatest modifications in this respect; and that car is likely to be the most popular with the patrons of the road which is so built as to enable freer ingress and egress of passengers, a matter which should not be lost sight of where there is competition between different lines to be taken into account. It is no little tax upon the engineer's ingenuity to get the best results in a new development, and still conform to the general lines of conventional car designs, some features of which have been based upon rules and practices primarily imposed for the greater safety of the traveling public.

Coming now to locomotive design, perhaps the most fundamental advantage which an electric locomotive has over its steam predecessor is greater mechanical simplicity, particularly as regards translation of the tractive effort from the motor to the wheel-rim. The absence of reciprocating parts is advantageous to a high-speed electric locomotive for passenger service, because of the lessened vibration of the locomotive itself, and the greater diminished wear and tear on the track. In the case of a slow-speed electric freight locomotive, the uniformity of tractive effort in hauling heavy train loads is a very desirable feature, particularly at starting. The tendency towards simplification and elimination of re-

ciprocating parts has caused the concentration of great weight at a less height above the rail than is usual for a steam locomotive of equivalent power; and this lowering of the center of gravity is not without its effect in running conditions at high speed, particularly upon a curved track. Steam locomotive men regard a high center of gravity as advantageous rather than detrimental, because its longer leverage from the top of the rail, which is the fulcrum, eases the side-thrust against the rails, due to whatever centrifugal force or lateral vibration there may be. So confident are steam engineers that this is a cardinal point of superiority that they express a desire to see electric locomotives so built that the essential difference between a steam and electric locomotive will consist in the replacement of the boiler upon the locomotive frame by an electric motor, in order to keep the center of gravity at something like its present height. If electric locomotive designers in this country keep as clear of the use of side-rods in the future as they have in the past, there does not seem to be much chance for increasing the distance of the center of gravity from the track to the height it frequently reaches with a steam locomotive; but in Europe some of the latest and most successful electric locomotive designs show a tendency to set the motors above the driving wheels, two motors being used to drive three axles through side-rods. The mechanical excellence of workmanship of these locomotives has been attested by some of the foremost electrical engineers of this country who have seen them. Whether or not the tendency of this design will persist, will depend upon how applicable this method of coupling proves to be to the loads and speeds met with in this country.

The latest developments in American locomotive practice as exemplified by machines actually in commercial operation or under test, show three types: first, that of which the driving wheel base is rigid, as in the case of the New York Central and the St. Clair tunnel locomotive units, the former having pony wheels, the latter, none; secondly, the articulated or bogie-truck type, with two large driving trucks pivoted to the locomotive body, each truck carrying a large motor on each axle; and a third type, now being tested by the Pennsylvania Railroad, which is built upon a locomotive frame of standard type, borne at the rear upon the outside journals of two large driving axles, each carrying a 500-horsepower motor, the forward end of the frame being carried upon a four-wheeled bogie truck generally similar to that commonly used with the American or Atlantic type of steam locomotive. This particular sample is designed primarily for single-phase traction, and a transformer is carried over the bogie-truck but not at a relatively great height above the rails. The superstructure of each of these locomotives is a steel-plate cab or enclosure housing the engineman and the control apparatus, but in no way approaching the weight of the boiler mounted upon the frame of the steam locomotive. The third type above described has appealed to steam locomotive men as conforming more nearly to their preconceived ideas of locomotive construction, but it remains to be seen whether American designers will work out any method that will result in further lifting the center of gravity along the lines followed by the latest European practice.

Railroad electrification invariably raises questions of safety to the traveling public. Both the third-rail and the trolley are frequently described in the daily press as "deadly." The fact that on a third-rail system a bad short-circuit can take place without blowing the station circuit-breakers, which have to be set for heavy overloads, sometimes results in serious blockades. When the damage is done it is usually expensive, and takes time to repair. In the case of a high-tension trolley system only a small leak is sufficient to cause a short-circuit, and the amount of actual damage done thereby is trifling. Such troubles as may be developed by short-circuits are generally not of long duration; whatever wires or cables are burned in two are burned quickly, and clear themselves promptly. With a high-tension system there is no possibility of confusion between an overload and a short-circuit.

Another feature of the question of safety involved is the dependence of a large number of electrical transportation units upon one power station as opposed, in the case of steam transportation, to an equivalent number of entirely independent units. It is perfectly possible for a disabled electric train to ground or short-circuit the line in its own vicinity in a manner that will prevent other trains from approaching. This is not the case with steam locomotive trains, as the terrible record of steam train collisions bears witness. Generally speaking, the combination of electric propulsion with the block-signal system for protecting trains has not been developed, though in the early days of the art the matter was occasionally brought forward as additional argument in behalf of electrification. The paramount desire to keep all traffic in motion has militated against the idea of permitting the disabled train or line-section to hamper in any way the movement of other trains on other sections. It is evident that there are possibilities along this line, particularly in the case of high-tension systems, that can justly receive further consideration, because with the smaller currents flowing in high-tension systems, control of them at a distance is relatively easier than in the case of the heavier currents in low-tension systems.

(To be continued.)

In a three-mile test run of two trolley cars, the journals of one being fitted with ordinary bearings, and those of the other with roller bearings, it was found that the former consumed 6.45 kilowatt-hours, while the latter used only 3.1 kilowatt-hours in the same time of running. An electric cab will run twenty-five per cent farther on one charge with roller or ball bearings than with plain bronze bearings.

The fact that it is impossible to generalize upon the capacity of single-track roads for train movement, renders it equally impossible to generalize upon the applicability of electric motive power thereto in comparison with steam. It is necessary to pick out a concrete case and estimate all the features in detail, just as it is in order to properly gauge the economic value of any other engineering enterprise. It is obviously unscientific to advocate wholesale electrification as a means of increasing capacity, when the capacity can be increased more cheaply, as it sometimes can, by the introduction of a block-signal system, or when the capacity of a piece of road even when equipped with a block-signal system, could not be increased in practical operation to a point that would enable enough more ton-miles per day to be run off at a lower cost per ton-mile, to show a saving in total annual cost.

The writer is a firm believer in the value of electric motive power as a means of increasing a railroad's earning capacity, but begs to suggest that in the future more professional papers be devoted toward giving concrete illustrations in a manner that will carry some conviction to the minds of the progressive and highly-trained specialists in transportation, who are doubtless willing to be convinced if the subject can be dealt with in a manner that appeals to their practical experience in the operation of trains.

ELECTRICAL CONTRACTORS' BANQUET.

It began for all with closed packages of buns. At its close some had acquired quite a package, but no one had a "bun" on. To a most elaborate love-feast the electrical contractors had bade each other and all allied interests on Saturday evening, January the eighteenth. By six-thirty many of

MAIN FOYER, FAIRMONT HOTEL

the guests had assembled in the spacious foyer of the Fairmont Hotel, and at seven o'clock they marched, nearly one hundred strong, down the beautiful ball room past Cerebus Wiggins, collecting from each his mite, into the "red room," resplendent in white and gold with brilliant red hangings and

BALL ROOM, FAIRMONT HOTEL

floor coverings. In this transplanted room of the Tuilleries was set a great table in the form of the letter "E" laid on its side, unconsciously being the initial of "Electricity." Trailing smilax introduced the green shade carried out in the menu cover. This, too, in contract form was familiar to many present. For two hours the guests did ample justice to the choice viands and fine wines, to be succeeded by a still finer feast of words.

MENU

Electrical Contractors' Association at the Fairmont Hotel.

This Agreement, made and entered into this eighteenth day of January, 1908, at the Fairmont Hotel, in the City of San Francisco, by and between the *Electrical Contractors' Association*, hereinafter designated as the Host, and its many friends in the *Electrical Fraternity*, hereinafter designated as the Guest.

Witnesseth :—That the Host, being the party of the first part, for and in consideration of the covenants and agreements herein contained on the part of the Guest, being the party of the second part, does covenant, promise and agree with the said Guest in the manner following, that is to say:

First. That the Host shall and will perform, finish and deliver, under the direction of the Chef of the Fairmont Hotel, the following articles, namely:

MENU

EASTERN OYSTERS ON THE HALF SHELL

MOCK TURTLE AUX QUENELLES

Sauterne

OLIVES RADISHES CELERY

FILET OF SALMON, MOUSSELINE

POTATO CHATELAINE

Cabernet

SIRLOIN OF BEEF, MONTAUSIER

ROAST SQUAB, EXCELSIOR

FRENCH PEAS

ICE CREAM NEAPOLITAN CHANTILLY

Champagne

ASSORTED FANCY CAKES

CAFE NOIR

Second. That the Guest shall test and prove the above articles through his natural organs of mastication.

Third. That should the Guest find the said articles to be of proper specific gravity, flavor and strength, and to be in every way up to the standard, the said Guest agrees not to imbibe too freely of the same, so as to cause him to lose his way homeward.

Fourth. In any event, it is mutually agreed between the parties hereto that the spirit of this contract is to have a good and enjoyable time, and in default thereof the sum of 23 Dollars shall be paid for each offense as and for liquidated damages.

In Witness Whereof, the parties hereto have set their hands and seals the day and date first above written.

THE ELECTRICAL CONTRACTORS' ASSOCIATION AND ITS FRIENDS IN THE ELECTRICAL FRATERNITY

(Seal)

Bob Martland as toastmaster gave the cue for much that followed. His ready wit and pleasing introduction carried forward the fun and pleasure of the evening. His opening remarks briefly outlined the history of the Electrical Contractors' Association, and detailed the good work already accomplished. In response to a call for a song, Frank Fowden responded with the "Stein Song" and "Brown October Ale." Major Kiefer, of the United States Army, followed with a fitting tribute to the men of San Francisco who had successfully faced the most trying situation of modern times, continuing with a plea for right treatment of the sailors soon to visit this city, and apparently concluded with a couple of good army stories. We say "apparently" advisably, for the irrepressible Major was bubbling over with verse and jest, to the edification of all, during the rest of the evening. Bibbins then had some interesting dreams of being at the circus, and also of being in Heaven, seeing many electricians in the latter place. He surprised us with some unusual obituaries of dead jobbers. Dropping his jocularity, he then sounded the key-note of the evening in an impassioned appeal for an organization electrical, a Utopia where each should "push the other fellow's game," if his own was hopeless.

As an invited guest, Billy Hynes gave some of his illimitable jests, finishing with a couple of rollicking songs, in which all joined with a mighty good will. Next, Jack Heyes, of the department of electricity, brought down the house by mistaking Billy Hynes, our public administrator, for Coffin, Hynes all the times thinking it a josh, and not realizing the strong resemblance that actually exists. Old King Cole, in replying to the toast of "Race Suicide," urged the advantage of organization and association in combating business suicide, ringing in a humorous reference to an Irish woman's business troubles. Hunt, of the San Francisco Gas & Electric Company, and Russel, of the General Electric Company, contributed their share of the entertainment by telling some "good" stories, which were not equalled by any of the professional talent from the Orpheum. Elliot, of the Jobbers, found the contract menu as the long-sought weapon with which to fight the lien (lean) law. His strong stand for fair play for every one had the unqualified endorsement of all present. George Fisk, President of Local Union No. 1, had "the same." After hearing from F. B. Meyers, Charlie Wiggins and Billy Hanscom, the party broke up at midnight, by singing "Auld Lang Syne."

Those present, reading from the left of toastmaster, Robert Martland, as shown in the picture of the banquet table, were as follows: C. E. Wiggins, of John R. Cole & Co.; E. B. Meyers, attorney for the Electrical Contractors' Association; L. R. Boynton, of the Central Electric Co.; Albert H. Elliot; W. G. Anderson, of the Henry Electric Co.; A. H. Halloran, of the "Journal of Electricity, Power and Gas"; W. R. Layne and George J. Wellington, of George J. Wellington & Co.; W. W. Hanscom, of the Century Electric Construction Co.; A. B. Vandercook, of the Telephone and Electric Equipment Co.; George A. Cole, of John R. Cole & Co.; Frank Fowden, of Brooks-Follis Elec. Co.; T. E. Bibbins, H. A. Russel, O. O. Lorring, L. E. Hehn and E. A. Hunt, of the General Electric Co.; G. Marcus, E. W. Schlessinger, of the Drendell Electric Manufacturing Co.; James T. Anderson, of the Electric Railway & Manufacturers' Supply Co.; Taliaferro Milton, John H. Hunt and F. S. Gray, of the San Francisco Gas & Electric Co.; John R. Cole, of Jno. R. Cole Co.; John W. Felt, of the Woodruff Co.; George M. Fisk, president of Local Union No. 1; A. D. Pierce, of the Shelby Electric Co.; G. A. Knoche, of Dunham, Carrigan & Hayden Co.; Wm. L. Goodwin, of the Sterling Electric Co.; Benj. C. Holst, of the California Electrical Works; C. C. Hillis, of the Electric Appliance Co.; Paul C. Butte, of the Butte Electric & Engineering Co.; Charles Hewitt, Wm. Adams, W. R. Dunbar, of the Westinghouse Electric & Manufacturing Co.; H. J. Rippan, R. P. Perkins and J. H. Frank, all of the Levy Electric Co.; W. W. Kirsten, H. G. Aylesworth; Phil Levy, C. C. Caven, E. W. Reginsburger and Louis Levy, of the Levy Electric Co.; F. B. Williams, of Whittman-Lyman Co.; F. B. Haake, of the Sterling Electric Co.; George L. Henzel, Frank J. Somers, of the Century Electric Co., of San Jose; H. A. Louw and J. F. Hetty, of Hetty Brothers; Harry W. Lewis, of Martland Elec. Co.; Benj. K. Martland, P. Decker, P. Murman and M. G. De Long, of the Decker Electric Co.; Wm. A. Ekberg, of the Sachs Fuse Co.; R. G. Rice, of Thompson-Starrett Co.; L. A. Nott; G. G. Loyst, of Hanbridge-Loyst Co.; Otto F. Schiller; Alvin H. Cobleigh; H. K. Finck, Jr., of Will & Finck; D. E. Hawes, of the Sterling Electric Co.; H. J. White, of A. S. Keeler Co.; C. I. McColgan; John J. Martin, of Bradley-Martin; John J. Heyes, of the Department of Electricity; Geo. J. Bradley, of Bradley & Martin; H. G. Levy, of the Electric Mfg. Co.; Stanley S. Morris, of Will & Finck; W. S. Hanbridge, of Hanbridge-Loyst Elec. Works; A. E. Drendell, of Drendell Electric & Manufacturing Co.; A. E. Rowe, of the Electric Appliance Co.; H. H. Dailey, of the Nernst Elec. Lamp Co.; E. D. Hand, of the Decker Electric Co.; F. H. Poss, of the Benjamin Elec. Co.; F. H. Woodward, of the Standard Electric Co.; Edward D. Poss of the Benjamin Electric Co.; C. E. Winchell, of H. W. Johns-Manville Co.; W. C. Brumfield, of the Novelty Sign Co.; H. D. Boschken, of the Garden City Electric Co.; M. J. Hynes and Major Charles Kieffer, who sat on the toastmaster's right.

ALASKA-YUKON-PACIFIC EXPOSITION.

The Alaska-Yukon-Pacific Exposition will be held in Seattle, Washington, during the summer of 1909. An appropriation of one hundred thousand dollars was made at the last session of the Legislature, in order that California may be properly represented at this exposition. California formerly enjoyed the Alaskan trade, but of recent years this trade has fallen away materially, notwithstanding the fact that the business of Alaska has increased to very large proportions. As this trade with Alaska will continue to increase as the country is developed, there is an opportunity for California to benefit by it in an increased commerce with that part of the United States, without materially affecting the present trade that is now in the hands of the Seattle people.

The Alaska-Yukon-Pacific Exposition will give California an opportunity to properly present its vast resources and its claims to a portion of the Alaskan trade, as well as to exploit same among the vast number of strangers from all parts of the world who will visit the exposition. The California Promotion Committee advocates that a building typically Californian be erected in Seattle, in which building all the people of the State will have recognition. There should be on exhibition in this building all things possible that go to make up California life—works by the best California painters, sculptors and writers, going back to the earliest history of California and leading up to the present day; picturesque scenes of California's scenic beauties, as well as scenes of California's industrial life; in fact, a complete word and picture scene of this State, accessible to all comers. In addition to this, a lecture hall of good proportions, where lectures on California will be constantly given by men competent to talk, the lectures illustrated by stereopticon views of the highest order. Then the building should be so arranged that it would be useful for large receptions and gatherings. It is notable that at other expositions the State buildings where the main feature was receptions were the most popular. In this connection, one has but to look back upon the San Francisco building in St. Louis at the time of the exposition there, and from it learn a lesson as to the lines on which a State or city may be properly represented.

HINTS ON INSPECTION OF CONDUIT.

D. McKellin.

When inspecting conduit work that is being installed, it is well to look out for the following points:

The duct for feeders should be large enough to pull a wire at least two sizes larger than what is immediately necessary so as to provide for future increase in number of lights, small motors, etc.

Should have no small bends so that there will be no excuse for faking the size of feeders or the thickness of insulation or using grease or oil when pulling in.

Should not be run too close to great heat such as boiler or steam pipes, as such proximity will cause the insulating compound to run and stick to the inside of the duct, causing difficulty should it ever be necessary to pull it out, and deteriorating the rubber of the insulation.

Should be so run that there will be no vibration communicated to the duct as this will in time cause it to break at the threads and admit moisture, or one broken end may hang on the wires in such a way that if a leak should occur it would burn away enough of the conduit to allow flame to be communicated to surrounding material. Also for the same reason the supports on hanging duct should be close together and so arranged that each will support its share of the duct and not leave the weight on a few supports and the remainder hanging loosely if not actually adding weight or strain to those that are tight.

It often occurs in cutting long threads on any kind of conduit that the die will start crooked, and by the time it reaches the limit of the cut one side will have cut down into the duct so far as to cause a leak or force a sliver of steel through so that it is bent down inside of the conduit in position to possibly tear the insulation.

It should be seen that all conduits enclosing wires which are carrying large currents are extra well grounded so as to blow a fuse in case of accidental ground rather than melt up a lot of steel and copper by not having a return circuit of low enough resistance. In this regard it is well to remember that conduit threads rust as time goes on, and that if there are only a few threads in contact with the coupling, the resistance will become greater than if exactly half of the coupling is in contact with each length of conduit, and that if the thread is loose in the coupling it will rust much quicker, and to a greater extent than if good and tight. This is most likely to occur in running threads, therefore, they should be well backed up by locknuts and should be seldom used in the large sizes of conduit.

The return circuit in case of accidental ground will be much better if the thread on the conduit is well cleaned with the die before being screwed together.

The reaming of conduits is a matter that should be watched carefully. If not reamed enough, it will scratch or tear the braid and be difficult to pull in. If reamed too thin, the ragged thread at the end is likely to turn down into the duct when forced up hard against the end it meets in the coupling, thus making matters even worse.

Another matter which is sometimes not given sufficient attention is the bonding together of ducts at the boxes. Ordinarily the locknut and bushing is depended upon entirely for continuity of the return circuit, and this is very poor dependence, as it seldom is tight enough to amount to much as a current carrying medium, and when it is forced up tight the contact is made on the enamel of the box in most cases. The contact thus obtained is usually enough to blow a six ampere fuse, but will give poor results on one of three or four hundred ampere capacity.

A careful inspection of the bushings on all sizes of duct to see if they are good and not likely to come off readily is one of the duties of the inspector. The size of the cutout boxes is an important item, because a box that is small will necessitate bad arrangement of the wires in order to accommodate enough cutouts and switches.

Many mechanics use grease, oil, soap, or any lubricant that comes handy to facilitate pulling in on long runs or runs of large wire, and the best grease does some harm to the insulation, while some kinds are exceptionally bad. Therefore, it is necessary for the careful inspector to look for indications of its use.

Powdered plumbago or soapstone will never harm good insulation, so are permissible, and are perhaps the only kinds of lubricants that should be allowed.

The inspector should try to be on the job when the pulling in is being done, if possible. In fact, the contractor should be obliged to notify him regarding the time when he will have his men at that branch of the work, because that is the time when even the fairly decent contractor will sometimes consent to a piece of "funny" work rather than tear out plaster or rip up flooring to make the job secure.

Many a cute trick is played on switch box covers at this time, too, where they have been installed out of plumb. Sometimes when too many taps have been run to the switch box or an end of one of the ducts projects too far in, a clever mechanic will break off a part of the porcelain of the switch to make it fit.

If the longest of the circuits has been pulled in in the absence of the inspector, he will sometimes gain considerable information by having a couple of them pulled out for examination.—"Electrocraft."

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

SOCKETS, STANDARD.

"Dazzlite" attachment for oil lamps, 50 C. P., 250 V. Cat. Nos. 5403, 5404, 5529, and 5530. Approved Dec. 9, 1907. Manufactured by

Harvey Hubbell, 35 Oregon St., Bridgeport, Conn.

CABINETS.

FA. Formed and built-up steel boxes and steel lined wooden boxes, including types Nos. 230, 236, 330, 336, 130 and 136. With or without slate gutters and with wood or steel fronts; with or without glass panels. Approved Nov. 6, 1907. Manufactured by

Frank Adams Electric Company, 904 Pine St., St. Louis, Mo.

CUT-OUT BASES, CARTRIDGE FUSE.

Single pole porcelain base cut-outs for use with special G. E. glass tube, enclosed fuses, 2 A., 250 V. Approved Nov. 25, 1907, on switchboards with fuses protecting instruments or pilot lights. Manufactured by

General Electric Company, Schenectady, N. Y.

Main and branch blocks 0-200 A., 250 V.; 0-100 A., 600 V. Approved Nov. 20, 1907. Manufactured by

Peru Electric Manufacturing Company, Peru, Ind.

FIXTURES.

FA. Straight electric and combination fixtures. Approved Dec. 16, 1907. Manufactured by

Frank Adams Electric Company, 904 Pine St., St. Louis, Mo.

FLEXIBLE CORD, PORTABLE (for electric heaters).

Double or triple conductor cords composed of braided conductors with rubber and asbestos covering, the several conductors separately protected by woven cotton braids and enclosed by an outer galvanized cotton covering. Approved Nov. 22, 1907. Manufactured by

General Electric Company, Schenectady, N. Y.

HEATERS, ELECTRIC.

"American" plate warmer, Cat. No. 440. For 125 and 250 V., equipped with approved heater cord and attachment plug. Approved Nov. 13, 1907. Manufactured by

American Electrical Heater Company, Detroit, Mich.

Portable Types, Disc Stove, Industrial Style, Cat. Nos. 3250, 3255, 3260, 3265, 3270, 3275, 3280, 3285. Domestic Style, Cat. Nos. 3220, 3230 and 3235. Water Heaters, Cat. No. 5215. Coffee Percolators, Cat. No. 5315; Tea Kettles, Cat. Nos. 5415 and 5420; Chafing Dishes, Cat. Nos. 335, 345, 337 and 347; Curling Iron Heaters, Cat. Nos. 117, 111, 113, 115, 150, 112 and 116; Glue Pots, Cat. Nos. 141 and 143. For voltage up to 250. Equipped with approved heater cord and detaching plugs. Approved Nov. 14, 1907. Manufactured by

American Electrical Heater Company, Detroit, Mich.

LAMP ADAPTERS.

Adapters for Edison base lamp in T. H. sockets and receptacles. Cat. No. 9357, 3 A., 250 V. Approved Nov. 25, 1907. Manufactured by

Marshall Electric Manufacturing Company, 301 Congress St., Boston, Mass.

MISCELLANEOUS.

A border for stage lighting, constructed of sheet steel and provided with approved receptacles, guard and wiring. Approved Dec. 16, 1907, when installed in compliance with requirements of Rule 31, A-4, N. E. Code.

PANELBOARDS.

FA. 125, 125, 250 and 250 V., two and three wires with and without branch circuit switches, open link Edison plug, or standard cartridge enclosed fuses, including "Standard" types, H, G, P. and HS. Also "Metering" panels when installed in metering closets or approved cabinets. Approved Nov. 9, 1907. Manufactured by

Frank Adams Electric Company, 904 Pine St., St. Louis, Mo.

RECEPTACLES, STANDARD.

Freeman. Two piece porcelain sign receptacle. Cat. No. 276, 3A., 250 V. Approved Nov. 9, 1907. Manufactured by

Freeman Electric Company, Trenton, N. J.

SWITCHES, KNIFE.

"Trio." 25 A. to 300 A., 250 V.; 25, 50, 75 and 100 A., 600 V., with and without extensions for standard enclosed fuses. Front and back connected, 1, 2, 3 and 4 pole. Also 15 A., 125 and 250 V, single and double throw, 1, 2 and 3 pole. Approved Nov. 23, 1907. Manufactured by

Trio Manufacturing Company, Rock Island, Ill.

WIRE, RUBBER COVERED.

Marking: Two green threads running parallel in braid. Approved Nov. 25, 1907. Manufactured by

Detroit Insulated Wire Company, Detroit, Mich.

FIXTURES.

Morse adjustable fixtures for mounting on benches or sidewalks. Cat. Nos. 1 to 5, inclusive. Approved Nov. 26, 1907. Manufactured by

Frank W. Morse, 516 Atlantic Ave., Boston, Mass.

INSULATING SUPPORTS.

A small one-piece porcelain device having opposed projecting pairs of lugs, designed to be used instead of tubes where wires are run crossing at right angles with each other. Cat. No. 5,212. Approved Nov. 25, 1907. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

CABINETS.

Cast-iron boxes for service entrance cut-outs and switches used with open wiring or with conduit work. Cat. Nos. 1,210, 1,212, 1,214, 3,601, 3,603, 3,605, 3,620-3,625, inclusive, and 3,630-3,637, inclusive. Approved Jan. 2, 1908. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

CUT-OUT BASES, CARTRIDGE FUSE.

"Trio," 1905. Standard type slate bases, O-300A., 250-V., O-300A., 600-V., one, two, three and four-pole. Approved Dec. 17, 1907. Manufactured by

Trio Mfg. Co., Rock Island, Illinois.

RECEPTACLES, FOR ATTACHMENT PLUGS.

Lang stage receptacle and plug. Base consisting of single piece of heavy porcelain. Hard wood plug for stage cable. For use in suitable iron or steel box. Approved Jan. 3, 1908. Manufactured by

J. Lang Electric Co., 116-128 N. Lincoln St., Chicago, Ill.

RECEPTACLES, STANDARD.

Weber Wall Sockets. Cat. Nos. 672 to 677, inclusive. Cleat, concealed and angle base types, 3A., 250-V. Approved Dec. 31, 1907. Manufactured by

Weber Electric Co., Schenectady, N. Y.

ROSETTES, FUSELESS.

Knowles cleat types. Cat. Nos. 2,500, 2,550, 2,696 and 1,601, 3-A., 250-V. Approved Nov. 19, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

3-A., 250-V. Cleat type. Cat. Nos. 602, 603, 607, 703 and 706, with porcelain sub-bases. Concealed type, No. 604. Moulding type, No. 608, and ceiling buttons Nos. 70 and 170. Approved Jan. 3, 1908. Manufactured by

Pass & Seymour, Solway, N. Y.

Electric motor-buses accommodating thirty-four passengers are running regularly in London. Each weighs seven tons when fully loaded, one and one-half tons being the weight of the storage batteries. They are equipped either with double-commutator motors, driving the differential through a longitudinal shaft which passes between the two halves of the battery, or with two separate motors driving a divided countershaft, from which the rear wheels are driven. The batteries are carried beneath in iron-bound crates, and are mechanically handled for charging at the rate of twenty per hour. A 40-mile run can be made with one charge, there being 42 cells in each crate. The total cost of running is about twenty cents per mile.

A German named Kufferath has invented a process of treating arc lamp carbons with a solution containing ½ to 1 per cent of a mixture of yttrium and lead nitrates. The light obtained from these carbons is said to be rich in actinic rays, rendering it specially suitable for photographic work.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to The Journal of Electricity, Power and Gas," Weekly.

Vol. XX JANUARY 25, 1908 No. 4

EDITORIAL.

METER RELIABILITY.

Now is the time that irate customers of gas and electric companies besiege the office with bitter complaints of overcharge, complaints often as unjust as they are disagreeable to all parties concerned. But satisfied customers are as essential to the success of the public-service corporation as that of the butcher or baker. Many are satisfied with merely registering their complaints, having had their say. They exemplify the story told of the man who was much incensed at the treatment accorded him by one of these companies. He had lashed himself to fever heat in his anger, and as he could not visit them personally, at the suggestion of a friend, he wrote a scorching letter, giving full vent to his pent-up feelings. When he had sealed and addressed it, his friend told him to tear it up, as its purpose had been accomplished. But as a rule it is better to suggest that earlier lighting in the evening and possible early morning needs have caused the increase, and if used for heating, the cold or damp weather of the season is usually sufficient explanation.

Yet the underlying cause of dissatisfaction is due to the mystery and prejudice usually attached to the meter, and a simple explanation of its working and purpose, together with directions for reading, will usually convince the most obdurate. The best method of gaining confidence is to teach the public to read their own meters and figure their own bills. A model in a glass case will show the analogy in principle and operation of the integrating service meter to an induction motor having a shunt and series winding that unite to form a rotating field. The eddy currents induced in the aluminum disc react to cause rotation, just as with the rotor of an induction motor, the driving torque being proportional to the energy passing through the circuit. A retarding torque is caused by the fields of two permanent magnets, giving steady rotation.

If this explanation proves too intricate for the obtuse understanding, the action may be likened to that of a motor-generator in which one edge of the disc with the current and potential coils is considered as the motor, and the opposite edge with the permanent magnets as the generator, the armature being the revolving disc.

The motion of this disc is transmitted by gears to the hands of the registering dials. There are usually four in number and are arranged in the same order as are the numbers in any column of figures, the figure shown by the dial on the right of the reader being placed in the units column, the next in the tens column, the next in the hundreds and so on. If the pointer lies between three and four on the dial, the reading is three, and in general the smaller number is the one to be read. Many will see the likeness to a bicycle cyclometer, the dial of which records the number of revolutions of the wheel. Most of these are compensated to read directly in miles, but it can be shown that with different wheel circumferences different constants are necessary. It is desirable for all meters to be of the same size, even when used for all capacities. The disc should not make over fifty revolutions per minute at any time to insure long life to the jewel bearings and to prevent mechanical troubles. Consequently these meters are adjusted at the factory so that one revolution of the disc means either one, two, three or any other predetermined number of watt-hours. But the meter mechanism records only the number of revolutions, the reading being correct if one disc revolution is caused by one kilowatt-hour, but necessarily multiplied by a constant 10 if it is caused by 10 kilowatt-hours. This explains the use of constants.

With these explanations clearly in mind, it should be shown that the reading is cumulative. Consequently to find the consumption for any specified time it is necessary to subtract the reading at the beginning of that time from that at the end of the time. By multiplying this number of kilowatt-hours by the unit-charge, the bill is determined. Meter manufacturers today turn out an article nearly perfect in accuracy, registering "within two per cent plus or minus from two per cent of full load to fifty per cent overload." Yet occasionally customers are not satisfied with the work done by their meter, in which case a test should be made. As a rule it is found that any discrepancy due to short circuits or lessening of magnet strength is against the company. All trouble on

both sides may be obviated by a realization of the fact that no meter manufacturer can afford to send out inaccurate instruments. They are mechanically and mathematically designed to produce correct results under operating conditions. If by any chance the meter reader cannot gain access to the meter, the charge is made on the corresponding readings for the same month of the preceding year. The next month's reading shows the current consumption for two months, and the bill is corrected accordingly.

The latest development in meters is the prepayment attachment by which small consumers may buy a "quarter's worth" as they need it. The line is automatically disconnected when the amount of electric energy used equals the amount of money deposited. This idea has already proved successful on gas meters, and saves much bookkeeping and bill collecting.

What has been said regarding the electric meter is also applicable to the gas meter, which is read in the same way. The accuracy of the gas meter is fully recognized by the laws of every county where gas is sold. Any mistake of overreading, which would cause the consumer to pay for his gas in advance, or of underreading, which makes him feel good for a short time, is compensated in the next month, as the record is continuous and permanent. The power required to drive the mechanism is furnished by the pressure of the gas, and consequently it is impossible for the meter to register when no gas is passing through it. Even the meter man has not discovered the secret of perpetual motion. Confucius said, "It is because men are prone to be partial toward those they love and unjust toward those they hate, that it is so difficult to find any one capable of exercising sound judgment with respect to the qualities of others." Confidence is the basis of success in the lighting business; complaints vary inversely with its growth. It is only by the mutual exercise of common courtesy and by open minds that universal satisfaction can be assured.

PERSONAL.

Alexander Henderson left this week for a brief visit to Honolulu and the Hawaiian Islands.

Alvin O. Foss has returned from an extensive trip throughout the East and has headquarters with Sidney Sproat, 619 Crocker Building, San Francisco.

A. T. Clark, president and general manager of the American Circular Loom Company, of Chelsea, Massachusetts, is visiting the Pacific Coast. During the past week he has been in San Francisco, arriving just too late to participate in the electrical men's Del Monte outing. But so well was the American Circular Loom Company represented there by Alexander Henderson and John R. Cole, the Pacific Coast sales agent, that Mr. Clark has required no introduction to the local electrical fraternity. He expects to be in San Francisco during part of next week before continuing his trip, which has already included Seattle and the Northwest. The great amount of construction work on this Coast draws a large proportion of their output of circular loom and electroduct conduit. A number of pleasant dinners were given by Mr. and Mrs. Clark to some of the leading electrical men and their wives.

PUBLICATIONS RECEIVED.

Vol. II, No. 9, of the Transactions of the Illuminating Engineering Society, in addition to the Society Notes, contains papers on "Inverted Gas Lighting," by M. C. Whitaker, and "Fixture Design from the Standpoint of the Illuminating Engineer," by V. R. Lansingh and C. W. Heck, together with discussions.

"The Gas Engine in Principle and Practice," by A. H. Goldingham, presents practical information on gas, gasoline and crude oil engines to the non-technical reader. After a historical introduction, including an outline of the general theory of gas engines, the author describes the various types of engines, comparing the two- and four-cycle types and carefully explaining the various details of valves, governors, igniters, etc., by well executed drawings. The chapter on testing is especially replete with detailed methods of obtaining the required data. Crude oil engines and the various gas producers are presented in the two succeeding chapters. The diagrams in the chapter on installation and utilization of waste heat are especially suggestive. The volume is concluded by a brief discussion of the practical operation and correction of the different types. The clearness and conciseness of the author's style does much to make plain many hitherto hazy ideas on thermodynamics. It is more of a compilation than an original treatise, but so well has this been done that the book takes the place formerly filled by several volumes. The data given seems to be reliable and up-to-date, and enables the reader to quickly grasp the essentials of gas engine operation. It is from the press of the Gas Power Publishing Co., of St. Joseph, Mich. The book will be sent postpaid for $1.50 by the Technical Publishing Company.

TRADE NOTE

Dossert & Company of New York, manufacturers of Solderless Electrical Connectors for Cable Joints, Stranded or Solid wires, have established a Pacific Coast agency with F. A. Lawson & Co. at No. 209 Monadnock Bldg., San Francisco, Cal. They keep in stock any sizes up to one million C. M., in cable taps and lugs. The Dossert Connector is said to be the only mechanical device to be used without solder that is approved by the New York National Board of Fire Underwriters.

MEETING NOTICE.

The January meeting of the Philadelphia Section of the Illuminating Engineering Society, was held in the Assembly Room of the Philadelphia Electric Company, Tenth and Chestnut Streets, on Friday evening, January 17th, at eight o'clock. Mr. F. N. Morton read a paper on "The History of Photometric Standards," illustrated by lantern slides.

Illuminating Engineering Society, January meeting, Chicago Section, was held January 17th at the convention hall, Coliseum Annex, as the guests of the Electrical Show management. The subject was the "Gas and Electric Illumination of Apartments and Small Houses."

REMOVAL NOTICE.

The Pacific Meter Company is now permanently located at 301 Santa Marina Building, California and Drumm Sts., San Francisco, California.

TRADE CATALOGUES.

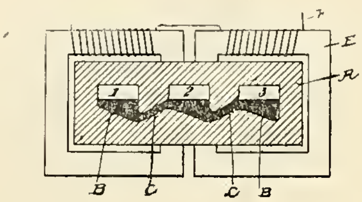
Bulletin No. 1102 from the Fort Wayne Electric Works gives a list of plants operating direct-current, direct-connected generators, Types M P and M PL for isolated light and power use. Bulletin No. 1103 illustrates and describes their series A. C. Arc Lighting System. The index to Bulletins Nos. 1001 to 1103 will prove most useful.

The Monthly Bulletin of the Ohio Brass Company contains an illustrated account of the latest types of catenary construction, together with data on electric railway and mine haulage material.

PATENTS

CONSTRUCTION OF INDUCTION ELECTRIC FURNACES. 875,801. Gustave Gin, Paris, France.

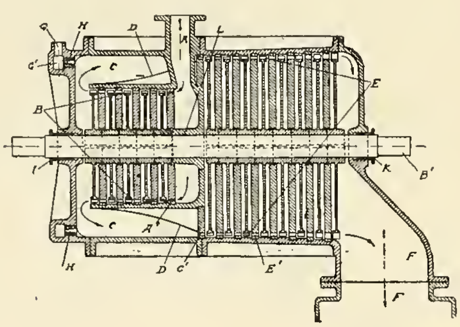
In a furnace, a hearth provided with a plurality of open channels of greater depth at one end than the other, a plurality



of laterally closed inclined conduits connecting the shallow end of each channel with the deep end of the adjacent channel and electro-magnetic means adapted to set up an induced electric current in metal contained in said channels and conduits.

TURBINE. 875,912. Bruno Heymann, Millers, Nev.

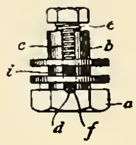
In combination, a shaft, a high-pressure set of vanes mounted thereon, a low-pressure set of vanes mounted thereon, means adapted to lead a fluid through said high-pressure set of vanes in a predetermined direction, a passage extending about and jacketing said high-pressure set of vanes and adapted to receive



the exhaust therefrom and lead the same to said low-pressure set of vanes, and means adapted to lead said exhaust through said low-pressure set of vanes in a direction substantially opposite to that of its passage through said high-pressure vanes, said high and low-pressure sets of vanes being adapted to exert substantially equal and opposite thrusts upon the shaft upon which they are mounted.

WIRE-CONNECTOR. 875,872. John J. Walsh, Yonkers, N. Y., assignor to Yonkers Specialty Company, Yonkers, N. Y.

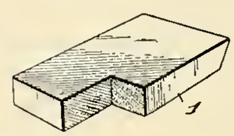
In a wire-connector, the combination of an internally threaded body portion, having a transverse slot to receive the wires, separ-



ating members having bars adapted to lie in the slot between the wires, and a screw in the body portion adapted to press the wires and separating members firmly together.

CARBON BRUSH FOR COMMUTATORS AND THE METHOD OF PREPARING SAME. 875,750. Edwin C. Van Nort, Jr., St. Louis, Mo.

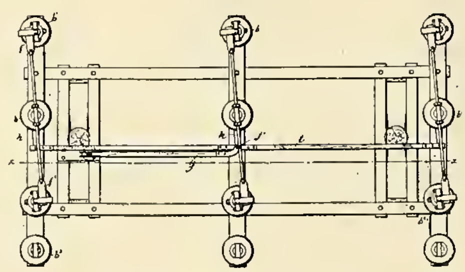
The method of preparing for use brushes for commutators, which consists in first taking a block of commercially prepared



commutator brush material, cutting said block into proper size for commutator brushes, and third, immersing the brushes in a boiling solution of paraffin, yellow wax and plumbago.

ELECTRIC SWITCH. 875,978. Frank G. Baum, San Francisco, Cal.

An electric switch for high-tension circuits, comprising a frame having upright and horizontal members, three rows of insulators mounted thereon, each row having two fixed insulators and an intermediate swivel insulator, arms carried by said swivel insulators and having portions forming blades at their extremities, metallic clamps on the adjacent fixed insulators and



having diverging clips arranged with their openings directed oppositely, and in the path of the blades of said arms, crank arms extending from the swivel insulators, a connecting member or bar joining the crank arms, a thrust bar connected to said connecting bar, a bell crank connected to said thrust rod, and an operating rod connected to the other arm of the bell crank.

INDUSTRIAL

VICTOR LAMP TESTING METER.

A new type of direct current meter has just been placed on the market by the H. W. Johns-Manville Co., of 100 William Street, New York, which offers many advantages to the inspector, lamp salesman, lamp manufacturer, etc. The movements are built on the familiar d'Arsonval pattern, and so placed with reference to each other and the scale, as to render the energy consumption directly readable at the intersection of the volt and ampere indicator needles. The special feature being the design which enables the operator to read at one glance the pressure, current and wattage on any lamp which may be inserted in a socket immediately above the meter.

The instrument is equipped with three self-contained shunts, one of 150 amperes capacity, having conveniently arranged binding posts, and a 1.5 and .75 ampere shunt, which is so connected within the base of the meter as to be readily thrown in circuit at will. In order to test a lamp it is only necessary to connect the attachment plug and cord to any lamp circuit, insert the lamp and read volts, amperes and watts without computation. The different shunts may be easily placed in circuit by the adjustment of a small screw-plug at the top and right of the instrument. The two smaller shunts have universal connections. The voltmeter may have either 150 or 300 volt scale or both. The most valuable feature of this instrument is the fact that accurate wattage measurement may be taken on a fluctuating load, as it is required to observe but a single point for such readings. The instrument is entirely self-contained and weighs less than fifteen (15) pounds complete.

STEAM TURBINES.

The Brush Electric Light & Power Company, of Galveston, Texas, which has been completely remodeling its plant and practically doubling its capacity, in response to urgent demands from customers for increased service, recently installed two Allis-Chalmers steam turbines and generators of 1500 kilowatt normal rating, with liberal overload capacity, and converted four of the smaller existing dynamos into motor generator sets of 400 kilowatt output, mounting them two by two on common bedplates with Allis-Chalmers induction motors of 300 horse-power each. To the steam producing plant, consisting of 1200 horse-power in Heine boilers, has been added sufficient capacity in Erie and Stirling water tube boilers, operating under a pressure of 150 pounds, to provide for the increase in the electric generating system.

The first of the new units to be installed was a 500 kilowatt machine to deliver two-phase, 60 cycle current with a pressure of 2300 volts, running at 3600 revolutions per minute; and, soon after this had been placed in operation, it was followed by a unit of 1000 kilowatt capacity, at 1800 revolutions per minute, with the same service characteristics.

Both turbines operate condensing, water for this purpose being taken from Galveston Bay and lifted by an induction-motor-driven centrifugal pump to two Tomlinson condensers, with discharge directly to the city sewer system, the condensed steam, which is entirely free from oil or other impurities, going, of course, directly to the feed-water heaters. All this auxiliary apparatus, as well as exciters, switchboards, etc., was also supplied by the builders of the new turbo-generator units.

The ordering of the turbines was hastened by an accident to the power-house which occurred during a heavy electrical storm some months ago, at which time lightning entered the station, despite the usual protective apparatus, and resulted in the breaking of a large driving belt connecting the fly-wheel of one of the principal engines to its generator. As a consequence, the engine ran away and completely wrecked itself. This, of course, is an occurrence which would not be possible with direct-connected turbine units, and the improved features of the Allis-Chalmers design, heretofore described at length in this paper, are such as to practically preclude similar trouble from any other source.

ELECTRICAL SHOW.

President George F. Parker announces that the Second Annual Electrical Show will open at Madison Square Garden, October 3rd, 1908. Unprecedented success marked the First Annual Electrical Show of 1907, the attendance for ten days numbering close to 130,000 persons.

A striking feature of the Second Annual Electrical Show will be the foreign exhibits. President Parker has been in communication with many scientists, electricians and firms in the old country and it is their intention to gain the advantages of this great public exposition at Madison Square Garden by noteworthy representation. The majority of last year's exhibitors intend exhibiting again with all the new and interesting electrical inventions known.

L. J. Mensch will make a series of tests of reinforced concrete poles on February 1st, 1908, at 2 p. m., at the factory, foot of Canal Street, East Oakland, near Twenty-third Avenue Station. Engineers interested are invited to be present. At the same time tests will be made showing the strength of hollow poles forty-four feet long.

TRADE CATALOGUES.

Allis-Chalmers Company send a copy of their Bulletin No. 1040, entitled "Polyphase Induction Motors." There are two types, designated at AN and AN(Y). Type AN motors have a rotor with "squirrel cage" winding and are suitable for all classes of constant speed service. Type AN(Y) Induction motors are provided with a wound rotor adapted to the insertion of resistance at starting or for obtaining variable speed.

NEWS NOTES

TRANSPORTATION.

Reno, Nev.—Steamboat Springs has been purchased from Colonel Hopkins by Dr. A. S. Brackett and associates. Dr. Brackett and company will expend $100,000 in building an electric line from Reno and in making improvements.

Visalia, Cal.—Rights of way are being solicited for the extension of the Visalia Electric Railroad to Three Rivers and on to the Giant Forest. The company has practically agreed to build the road into the forest if rights of way are obtained.

Wenatchee, Wash.—Construction work on the Priest Rapids Railway Company's line, from Waterville district to Kennewick, along the Columbia River, will begin early next spring. W. R. Rust, president of the company, who is now in Europe, will start the work on his return.

San Diego, Cal.—The Council has adopted an ordinance granting a right of way to E. W. Peterson, to construct and maintain a railway with the necessary sidings, switches, and bridges along certain highways at South San Diego. Work is to be completed in from four to eighteen months from the date of the franchise.

San Rafael, Cal.—In railroad circles it has been rumored that the North Shore management contemplates extending the third rail electric system to Point Reyes station this year. Superintendent Zook, of the railroad, has appeared before the Board of Supervisors and succeeded in securing a right of way 100 feet wide for a railroad near Point Reyes station.

Salt Lake, Utah.—The Utah Light & Railway Company has accepted the franchise passed recently by the Council. The company is controlled by E. H. Harriman, and has appropriated $5,000,000 for reconstruction and new equipment. Actual construction work will commence this week on a new passenger station, to be used jointly by the Harriman lines and the Salt Lake route.

San Francisco, Cal.—The United Railroads has commenced operating a new line, running on Mission Street from Twenty-ninth to Sixteenth, across Sixteenth to Market and Church, Duboce Avenue, and thence on Fillmore Street to Broadway. The Chutes line will be operated over Mission from Twenty-ninth to Sixteenth, Church, Duboce Avenue, Fillmore Street, and out Oak Street to Devisadero, and along Sacramento Street and Sixth Avenue to the Chutes.

Santa Cruz, Cal.—President J. Downey Harvey and the chief engineer of the Ocean Shore Railroad are conferring with citizens who are interested in raising funds for promoting the Ocean Shore Railway. Citizens have subscribed for many thousand dollars' worth of bonds, and it is proposed to raise $100,000. The road at this end extends up the coast twenty miles to the town of Folger, and the work of extending the line is now going on.

Sacramento, Cal.—Two freight motors of a new type are being constructed by the Northern Electric Company in the Chico car shops, and in sixty days they will be in operation between Chico and Sacramento. The motors are built on the box car style, and have a cab in one end for the motorman and electrical machinery. The value of the new motor is that local freight is carried in the motor itself, and saves switching a box car up to a station, and leaving it.

Los Angeles, Cal.—A new third-rail system for propelling electric cars has been tested on a specially prepared track at Beverly Hills, near this city. The experiment was witnessed by representatives of Los Angeles transportation companies, and may be adopted. The inventor, Timothy Maloney, a resident of this city, propelled a car at the rate of twenty-five miles an hour, and claims that it could have attained twice that speed. Two parallel rails between the tracks supply the current. At intervals of about half the length of a car there is a "cut-off" or break in the rails, which takes the current into a box at the side of the track and leaves the rails over which the coach has just passed "dead."

Oakland, Cal.—A compromise has been reached between the residents of East Oakland and the Oakland Traction Consolidated, by the terms of which the railroad company will abandon its franchise along Third and Twelfth Avenues and operate cars over Sixteenth Street from First Avenue to Thirteenth. Two weeks ago the residents protested to the City Council against the service given by the traction company along its Third Avenue and Sixteenth Street lines. This was answered by a petition from the car company for permission to abandon the entire franchise of which the complaint was made. The Clinton Improvement Club and citizens living in the vicinity of the car line protested, and at a recent conference an understanding was reached. The traction company has guaranteed a ten-minute service during the day time and a twenty-minute night service.

WATERWORKS.

Alameda, Cal.—The City Trustees have about decided to lay a six-inch main in Webster Street at a cost of $5,000.

Eureka, Cal.—J. N. Lentell has filed a claim on 15,000 inches of water in Mad River for the announced purpose of bringing a water supply to Eureka.

Pasadena, Cal.—The Lake Vineyard Company contemplates the laying of a thirty-two-inch main from Devil's Gate station to reservoir No. 1, on Mountain Street. It is estimated that the cost of this improvement will exceed $20,000.

Tucson, Ariz.—The contract for the waterworks extension has been let to the American Light & Water Company for $251,940. There will be twenty-five miles of additional street mains. City bonds will be accepted as payment.

TELEPHONES.

The Ephrata-Moses Lake Telephone Company, organized at Ephrata, Wash., west of Spokane, a short time ago, has awarded a contract to Harvey Hite for the construction of a line to connect the present line south of Ephrata with the Moses Lake Postoffice. The line will tap an irrigated district of more than 100,000 acres. The members of the company are: I. N. McGrath, C. Tichacek, Harvey Hite, J. M. Pate and the firm of Gibbons Bros. & Loving.

The Elk City extension of the Stites-Elk City Telephone Company, has now reached Newsome, the half-way point, and it is expected that the line will be completed to Elk City, Idaho, early in February. The line is built by an independent company composed of business men of Stites and other towns served. The equipment is first-class, the line being copper metallic circuit. This service is furnished much cheaper than the schedules of old companies, and it is believed the line will secure much business.

Work on the government telephone line, sixty miles, which penetrates the Idaho forest reserve, is progressing rapidly, the wire being in use several miles up the middle fork of the Clearwater River. The line is installed by the Forest Reserve Bureau, without cost to patrons. Homesteaders and settlers along the line can secure service, the only requirement being that they purchase their own instrument. Thirty miles of line is in operation. While the line is being erected, the same service is building roads and trails, which afford easy ingress to the forests.

Spokane, Wash.—One hundred and fifty miles of lines will be constructed by the North Idaho Telephone Company, organized at Wallace, with headquarters at Kellogg. The capital stock is $25,000 in 1,250 shares of $20 each. Three thousand two hundred dollars has been paid into the treasury. The stockholders are: D. W. Price, W. W. Papesh, W. F. Goddard, S. L. Shonts, Isaac Babbitt, P. P. Weber, L. W. Gay, Robert Sterling, Benjamin Carrigan, Curtis Lightner, ten shares each; Stanley A. Easton, W. C. Clark and A. M. Nash, twenty shares each. The company has received a franchise from the city of Wallace and will connect the various camps in the Coeur d'Alene mining district and connect with the Interstate Telephone Company for long distance work.

J. M. Welty, of Metaline, Wash, north of Spokane, has applied to the Board of Commissioners of Stevens County for a thirty-years' franchise to build a telephone line between Metaline and Colville. He wants the citizens of Colville to organize a company for the purpose of building and operating telephone lines throughout the county, and has $1,500 pledged from Metaline and seven miles of wire and material to proceed immediately on the construction of the line between Metaline and Ione. Mr. Welty was for five years construction foreman and inspector in eastern Washington and Oregon for the Pacific Telephone Company, with headquarters at Spokane, and is thoroughly conversant with the opportunities for an independent telephone company.

ELECTRIC RAILWAYS.

Jay P. Graves, president of the Spokane & Inland Electric Railway Company, has sent a letter to the stockholders showing that during the six months following April 30th the net earnings of this line have been $617,-732.67, and the expense has been less than 60 per cent of the gross earnings. The earnings report shows steady progress, the lowest month being May, with a total of $78,290.75, and a steady increase until October shows earnings of $122,898.74, an increase of more than 80 per cent in six months. Regular dividends of 5 per cent have been paid on the preferred stock during the past year, the dividends being paid quarterly in installments of 11-4 per cent each three months. The operating expenses, including taxes, rentals, insurance and all proper charges for maintenance, were less than 60 per cent of the gross earnings, leaving net earnings for the six months of $247,956.48, of which, after interest charges on bonds, and the July and October preferred dividends had been paid, there was left a surplus of $21,801.48. The usual quarterly dividend of 1¼ cents preferred, payable January 20th, will be postponed, as it is stated that the earnings for the six months succeeding October 30th will probably be reduced, though it seems reasonably probable that lumber and wheat shipments alone have been delayed. The letter adds: "Under existing conditions, bonds can only be disposed of at a heavy discount, at a sacrifice which we are not disposed to accept. We have therefore concluded it the part of wisdom, in the best interests of all concerned in the company, to pass the present regular quarterly dividend." Mr. Graves points out that the $1,000,000 power plant, nine miles north of Spokane is nearing completion, and says this will mean a vast saving in the expenses of the road, as it will then furnish its own power, while the completion of the extension from Palouse, Wash., to Moscow, Ida., will mean a heavy increase in the gross receipts. Stockholders are well pleased with the showing of the road and the prospects for the future. The electric line is doing more than was at first expected in the way of settling up the country, as more small farms have been sold along its line during 1907 than were sold in the same territory in ten years previous, is the claim of those who have been investigating the matter.

OIL.

Ventura, Cal.—The Union Oil Company has been awarded a franchise for a pipe line from Montalvo to Oxnard and Hueneme. They were the petitioners for the advertisement of the franchise.

Ventura, Cal.—F. E. Good, of the Bard Oil & Asphalt Company, has under construction in the Union Company's yards, a loading plant, where the heavy oil will be loaded on tank cars. A big pipe line will be laid to Santa Paula to transport it.

El Centro, Cal.—Oil has been struck in Imperial County close to the San Diego line. J. M. Holloway of Bakersfield has secured a flow of light grade oil at 180 feet in Cariso Creek Canyon. He has filed 300 claims. The stretch from the Mexican line forty miles northward has been looked upon for some time as promising territory.

San Francisco, Cal.—The following statement has been issued: "We will pay on day runs in either Kern, Sunset, McKittrick or Coalinga fields forty cents per barrel for oil of not less than fourteen gravity. This statement is made for the purpose of setting at rest rumors to the effect that we have offered higher prices. Associated Oil Company."

POWER AND LIGHT.

Spokane, Wash.—Mines in the eastern part of Okanogan County and the Chekapa mines on the west, and the territory reaching from the British Columbia boundary on the north to Brewster at the mouth of the Okanogan River on the south with boundaries to Chesaw and Molson, in north central Washington, will be supplied with electricity for lighting and power purposes by the Similkameen Power Company, which has just received a fifty-years' franchise from the Commissioners of Okanogan County, northwest of Spokane. The company, capitalized for $1,200,000, has a 1,500-horse-power plant at the falls of the Similkameen River, where it is purposed ultimately to generate 10,000 horse-power. The officers of the company are: President, Monroe Harman, Nighthawk, Wash., president of the Ruby mine and vice president of the First National Bank of Oroville; vice president and secretary, Charles A. Andrus, a mining capitalist of Nighthawk; treasurer and general manager, H. W. Johnson, Oroville. The principal owner of the stock of the company is the estate of James M. Haggerty, of which L. L. Work, of Conconnully, Monroe Harman and Dr. S. P. Ecki are executors. The company plans to provide electricty for lighting and manufacturing in a territory in the district mentioned in the foregoing, in addition to which its franchise gives it rights to certain streets in Chesaw, Molson, Nighthawk, Loomis, Conconnully, Riverside, Omak, Okanogan and Brewster. The plans take in routes on the east and west banks of Osoyoos Lake to the British Columbia line and on both sides of the Okanogan River to Brewster, thence on the west side of that river to Brewster. A line is proposed also from Nighthawk via Loomis to Conconnully. The town of Oroville is now lighted by electricity furnished by this company, which is an Oroville corporation.

ILLUMINATION.

Sacramento, Cal.—The City Trustees by a vote of three to five have declined to act on the Cory report on a municipal lighting plant.

Riverside, Cal.—Permission has been granted to the Corona Gas & Electric Company to erect and maintain a pole and electric transmission line over one of the Corona highways.

San Diego, Cal.—The City Council has under consideration petitions calling for half a hundred lights in various parts of the city. They will take a trip over the city one evening next week to investigate the electric lighting proposition.

Quincy, Cal.—The Quincy Electric Light Company is preparing to install a new and up-to-date plant as soon as conditions in the spring will warrant it. The new plant will have a capacity of 2500 lights of sixteen candle-power. As conditions are now, the present plant is greatly overtaxed.

San Jose, Cal.—Owing to the fact that the members of the Common Council consider the bid of the United Gas & Electric Company for one-year lighting contract excessive, it has been decided to put through an ordinance providing that rates shall be fixed by the Mayor and Common Council, based on sworn statements from the company.

Petaluma, Cal.—The City Trustees, at the suggestion of the consumers of gas and electricity in this city, have taken steps to regulate the rates of the Bay Counties Power Company, which supplies the local public. Santa Rosa, which is supplied by the same company, gets gas and electricity for half the price paid here. If no reduction is made, the city threatens to hold an election for municipal ownership.

CLASSIFIED LIST OF ADVERTISERS

THE

Journal of Electricity, Power and Gas

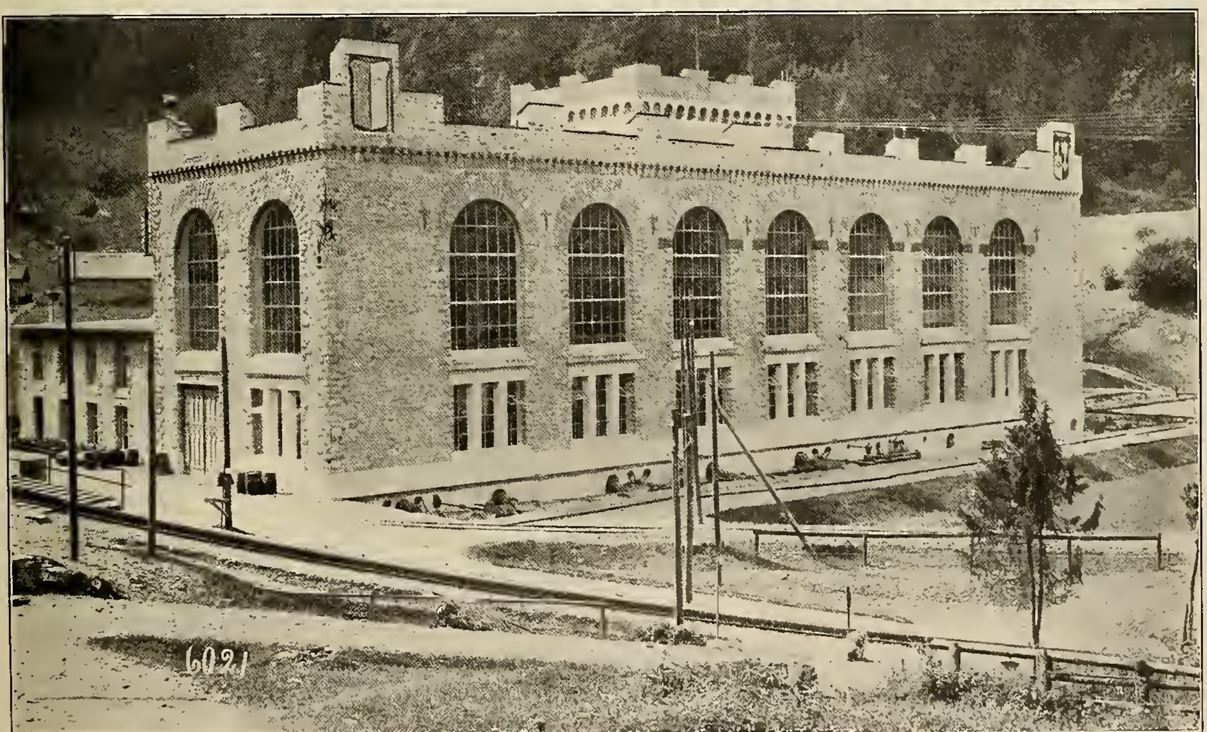
WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

VOLUME XX. SAN FRANCISCO, CAL., FEBRUARY 1, 1908 No. 5

THE OBERMATT HYDRO-ELECTRIC POWER PLANT.

One of the most thoroughly up-to-date electric power transmission systems in Switzerland is that supplied with current from the Obermatt hydro-electric station, near Luzern. This modern electric power transmission equipment cost more than a million dollars, the electrical part costing nearly two million francs, the remainder being expended for land, buildings and hydraulic construction. The city of Luzern supplied about nine-tenths of the capital required by the Elektrizitatswerk Luzern-Engelberg A.-G. The accompanying illustrations and drawings show the details of construction, the hydraulic and electrical equipment of the power station in Obermatt, near Engelberg, as well as the electrical connections and equipment of the sub-stations at Luzern, Steghof and Kriens, together with the transmission line supplying current from the Obermatt power house.



OBERMATT CENTRAL POWER STATION

The water is carried from the river Erlenbach, near Engelberg, into a natural reservoir, near that city, having an area of twenty-two thousand square meters and a capacity of seventy thousand cubic meters. This natural reservoir is 990.8 meters above the sea level, and has a depth of three and a half meters. The crown of the dam is half a meter above the high-water mark, and an overflow race has been provided ten meters wide. The water is conducted from this natural reservoir through a cement conduit a distance of 2,558.6 meters, the cross-section being 4.15 square meters. The total fall from the reservoir to the entrance of the penstocks at the Obermatt power plant is 3.06 meters, or 1.2 per cent gradient, while the fall through the penstocks to the water wheels is three hundred meters.

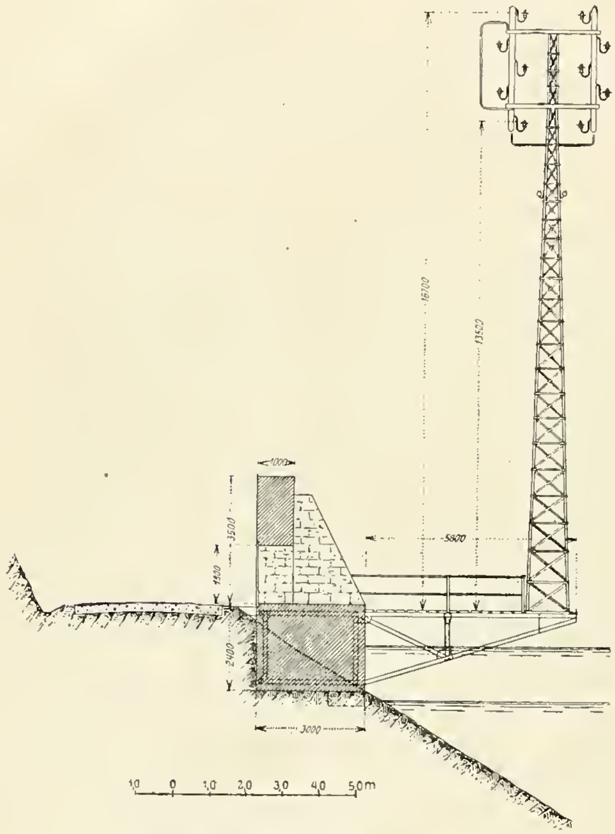
The concrete conduit from the reservoir was constructed in four sections, 458.84 meters, 781.8 meters, 650.5 meters and 667.46 meters in length. There are two penstocks installed, with provision for two additional ones at the "Wasserschloss," the entrance to these penstocks being 2.1 meters from center to center. They are arranged in four sections, the one nearest the Obermatt power house having a grade of 28.658 per cent, and being about 55 meters long, the next having a gradient of 61.968 per cent, its length being about 125 meters long, while

the third section has a length of 160 meters, the grade being 82 per cent. The highest section of these penstocks has a gradient of 60.39 per cent and measures 240 meters in length. The water is conducted to two turbines by each pipe at the rate of 1.33 cubic meters per second as a maximum. The thickness of the steel pipes being twenty-five millimeters.

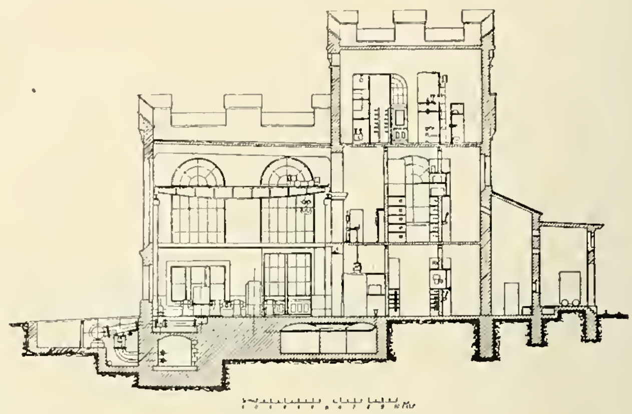
The hydraulic equipment was installed by Theodor Bell & Cie, of Kriens, and the Gebruder Sulzer, of Winterthur, Switzerland. The pipes furnished by the latter firm for the penstocks are anchored at various points along the four sections, each of which terminate in substantial concrete and masonry construction, the former being constructed of Siemens-Martin steel furnished by the Dillinger Huttenwerke.

The 2,000-horsepower, high-pressure turbines operate at a speed of 300 revolutions per minute, and are regulated by automatic governors of the Bell hydraulic Servo motor type, which are said to be most efficient and highly satisfactory. It is stated that with a change of load of 600 horsepower the speed will vary only one-half per cent, and with a load variation of 1,120 horsepower the speed varies one per cent, while the variation is stated to be not over two per cent and three per cent, respectively, for changes of load of 1,610 horsepower and 2,000 horsepower.

The Obermatt turbine and generator room is twelve meters high, thirteen meters wide and fifty-four meters long, and it is provided with an electrically-operated overhead traveling



STEEL POLES OF TRANSMISSION LINE.



OBERMATT POWER HOUSE.

crane of thirteen tons capacity for serving the seven turbines and seven-alternator and exciter dynamos. The current is generated at this hydro-electric plant at a pressure of 6,000 volts and raised to 27,000 volts by step-up transformers for use on the transmission line to Luzern, a distance of twenty-seven kilometers. At the sub-station Steghof, in Luzern, the current is reduced in pressure to 2,650 volts and distributed through an underground cable system to the various city transformer stations.

The alternators at Obermatt weigh 36,000 kilograms each and supply a three-phase current having a frequency of fifty periods per second, with an efficiency of ninety-six per cent. The maximum temperature elevation of these alternators, after operating twenty-four hours at full load, is said to be forty degrees Centigrade above the temperature of the surrounding air. The insulation of the armature winding was tested to double the working pressure, or 12,000 volts.

These generators, as well as the exciters and the alternator for the Stansstad-Engelberg Railway, were constructed by the Maschinenfabrik Oerlikon or Oerlikon, near Zurich, Switzerland. The railway generator has a capacity of 540 K. V. A., and has a pressure of 780 volts, the alternating current having a frequency of thirty-two and one-half cycles per second. This machine operated at a speed of 490 revolutions per minute, and has an efficiency of ninety-four per cent.

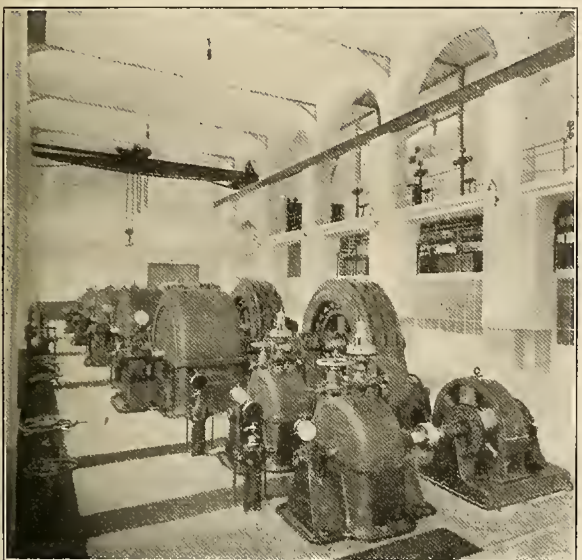
The exciter dynamos each have a capacity of 100 kilowatts and operate at a speed of 700 revolutions per minute, generating a normal current of 100 volts pressure and 100 volts maximum. These machines have commutators with 120 copper

The Obermatt power station is 680.8 meters above the sea level, and there is a net fall of 300 meters to the turbines, each of which has an efficiency of 75 per cent, and develops 2,000 horsepower, the water used being one cubic meter per second. There are four turbines of the high-pressure bell type installed in this power house, each having a capacity of 2,000 horsepower, one of the four units being held in reserve. To each of these turbines is directly coupled a single-phase and three-phase alternator of 1,380 K. V. A. and 1,850 K. V. A., according to operation as monophase or polyphase machines.

In addition to the four turbines above mentioned, there are two exciter sets with turbines of 175 horsepower each, and a railway generator unit having a direct-connected alternator driven by a 600-horsepower turbine, this generator supplying current for the operation of the Stansstad-Engelberg electric railway.

segments, and they have an efficiency of ninety-two per cent. A storage battery plant has also been provided at the Obermatt hydro-electric plant having a capacity of 1,000 ampere-hours, with a maximum discharge of 1,000 amperes in a single hour, while the battery is capable of supplying a maximum discharge of 1,500 amperes for a quarter of an hour. This storage battery plant is used not only for supplying exciting current, but also for the power station lighting.

The current for transmission to the Steghof and Kreins sub-stations is raised in pressure by step-up transformers of the Oerlikon water oil cooled type, three single-phase transformers being arranged in a group for each electrical generator.



INTERIOR OF OBERMATT PLANT.

These transformers have an efficiency of ninety-eight per cent, and are capable of carrying a fifty per cent overload for half an hour and twenty-five per cent overload for two hours, without injury. The 6,000-volt and 27,000-volt switches and circuit breakers are of the oil type and the busbars, lightning arresters and switchboard equipment are of unique modern construction.

The high-tension power transmission line from the Obermatt plant to Luzern, measures 26.83 kilometers in length. The first line consisted of a single-phase circuit for lighting service in Luzern, about 1,600 kilowatts being used. There is a reserve circuit of three conductors of 88 milimeters diameter each, and two power lines of the same number of conductors of the same diameter, mounted on steel poles and towers erected on masonry and concrete foundations.

In addition to the power-transmission lines on these steel poles, there are two bronze conductors, 3 millimeters in diameter, for telephone service and for signaling. At each pole, for grounding, a copper wire 5 millimeters, is provided with a copper plate having an area of 1 square meter, the above being arranged at every tenth pole. The cross-arms at the top of the poles are 2.1 meters apart, while the total height of the poles is 16.7 meters.

At the Steghof sub-station, the step-down transformers for lighting service are of 700 K. V. A. capacity, while the power transformers are of 300 K. V. A. capacity, designed for lowering the pressure from 27,000 volts in the primary to 2,650 volts in the secondary, the frequency being 50 periods per second. In this sub-station there are also 3 motor generator sets, each consisting of a three-phase motor of 2,650 volts, operating at a speed of 490 revolutions per minute, and driving a direct-current dynamo of 300 kilowatts' capacity, supplying a current at 575 volts pressure. A storage battery is also provided, and the switchboard includes 15 panels for railway feeders, as well as the usual sub-station apparatus of high tension and low tension, together with measuring instruments, lightning arresters, bus-bars and oil switches.

The Kriens sub-station is 4 kilometers distant from the Steghof sub-station, and is equipped with a step-down transformer of 450 K. V. A. capacity, designed for lowering the pressure from 25,000 volts in the primary to 500 volts in the secondary. There is also a sub-station at Stansstad, which is equipped

27000 VOLT BUS-BAR ROOM.

with two sets of transformers of 250 K. V. A. capacity, designed for lowering the pressure from 25,000 volts to 5,000 volts, the latter being used for distribution at Stansstad, other transformers being provided for lowering the pressure again from 5,000 volts to 350 volts.

The iron poles of the transmission line number nearly 500, with a total weight of 371.6 tons, and costing 123,000 francs, or about 262 francs each, or .33 franc per kilogram.

The power plant, including the generators, turbines, transformers and storage-battery plant, as well as the switchboard equipment, cost a trifle over half a million francs, while the transmission line from Obermatt to Luzern, including the transformer sub-stations, with their equipment, cost nearly three-quarters of a million francs.

TRADE CATALOGUES.

The Series Luminous Arc Rectifier System developed by the General Electric Company, Schenectady, N. Y., permits the operation of direct-current luminous arc lamps from alternating current central stations at high economy and with extreme simplicity, and is described in Bulletin No. 4556.

The General Electric Company, Schenectady, N. Y., describes a new line of cylinder controllers with improved magnetic blowouts which can be used on systems on which the voltage peaks reach 750 volts, in Bulletin No. 4557, recently issued. The bulletin gives the details of construction and dimensions of the different controllers.

INLAND EMPIRE DEVELOPMENT.

Three million dollars was expended in the development of water power in the Spokane River for transportation and commercial purposes in 1907, thus adding nearly 25,000 electrical horsepower to the output, placed at 46,000 horsepower, a total of 71,000 horsepower, and it is expected that 50,000 horsepower will be added this year, in various parts of the Inland Empire. The most pretentious work was the building of the $1,000,000 power plant for the Spokane & Inland Empire system at Nine Mile, nine miles north of Spokane, which will be in operation next April.

To utilize the water of the river at that point for generating electric energy the building of a mammoth dam was necessary. The dam and buildings in which the machinery is now being installed were completed last November. With the machinery constituting the initial installation the Nine Mile power plant will generate 20,000 horsepower. The current will provide the motive power for running all the trains of the Spokane & Inland Empire system, which operates 149 miles of electric road.

In the improvement of its power plant at Spokane Falls, Spokane and at Post Falls, twenty-four miles east of Spokane, the Washington Water Power Company made extensive additions of machinery. In the Spokane plant the company completed the installation of a 1,500-horsepower motor generator the latter part of December. This serves the purpose of converting the high voltage alternating current to a direct current of low voltage. The company has placed an order for a 2,000-horsepower motor for converting the current generated at Post Falls.

A 3,200-horsepower turbine driven generator was added to the equipment of the Post Falls plant last year. This plant now comprises four 3,200-horsepower generators, and the company has placed an order for one more turbine-driven generator of the same developing capacity, which will be installed in April. The Post Falls plant is developing 10,000 horsepower at Spokane Falls, and with the addition of the machinery contemplated it will deliver 13,000 horsepower in Spokane.

The Washington Water Power Company has in preparation plans for increasing the generating capacity of the Spokane plant to 40,000 horsepower. The head of water from which the power is now derived is 78 feet above the turbines from which are developed 15,000 horsepower. The plans provide for the extension of the flumes to the extreme high head of water, between Washington and Division Streets. By the extension a total fall of 134 feet will be conducted through the flumes and provide nearly three times the power now developed.

With the current generated at the Spokane and Post Falls plants, the company operates ninety miles of street railway in Spokane, electric lines to Medical Lake and Cheney, the Spokane electric lighting system, and furnishes electricity for lighting systems and power in Coeur d'Alene, Post Falls, Idaho, Colfax, Palouse, Tekoa, Farmington, Garfield, Oakesdale, Rockford, Medical Lake and Cheney, in addition to that consumed in Spokane in the operation of mills, factories and for general purposes.

The Big Bend Water Power Company, capitalized at $2,000,000, has completed plans for the construction of a plant twenty-eight miles west of Spokane, on the Spokane River. This plant will have a capacity for developing 20,000 horsepower. The company proposes to begin work next spring to insure the completion of the plant in less than two years. The Chicago, Milwaukee & St. Paul also is planning to develop much electrical power on the St. Joe River in Northern Idaho, east of Spokane, and will use this power in operating its trains over the Bitter Root Mountains.

The Washington Water Power Company completed the Cheney suburban line during the year. It also completed a steam auxiliary station and strung a high power line to the mines and the Coeur d'Alene district, 140 miles.

The Spokane & Inland Empire Company completed extensions of the Spokane & Inland electric line from Waverly, thirty-four miles south of Spokane, to Spring Valley Junction, and from that point by two lines, the present terminals of which are Colfax and Palouse. The total length of the extensions completed is eighty-two miles.

The Coeur d'Alene & Spokane electric line of the Inland Empire system was double-tracked from Greenacres to Spokane Bridge, six miles, and a branch two miles in length was built to Liberty Lake.

Announcement is made that the Spokane & Inland Empire Electric Railway system has adopted the Steptoe Canyon route in reaching Clarkston and Lewiston, south of Spokane, and it is expected that a permanent survey will be run in a short time and construction work begin next spring. The mouth of the Steptoe Canyon strikes the Snake River nine miles below Clarkston, and a fine grade is allowed from the Palouse plateau to the river. The survey runs along the north bank of the Snake River to a point near Dry Gulch, where it crosses to Clarkston. The plan in entering Lewiston is to bridge the Snake River.

TUNGSTEN.

The United States, with 1250 short tons, gave nearly one-third the world's production of tungsten in 1907, another one-third coming from the Australian states and New Zealand, and the remainder from Portugal, Great Britain, Malay Peninsula, Spain, Austria, Germany, France and Bolivia. Boulder County, Colorado, and Kern County, California, have produced most of the tungsten in this country. Cochise County, Arizona, produces a small amount, and deposits are known at Lordsburg, New Mexico; Loomis, Washington, and Butte, Montana. Market prices at the end of December were $420 to $450 per ton for concentrates carrying 60 per cent tungsten acid. The unique properties of tungsten for the manufacture of ferro alloys (used in hardening steel), as well as for the preparation of the filaments of incandescent lamps and for many minor industrial purposes, have created a demand which promises to increase steadily. As a result, prices have advanced, which in turn have initiated energetic prospecting for deposits of tungsten not alone in the United States, but in every country in which there is a possibility to make a discovery. Consequently the supply is getting larger, but consumption, especially in the European steel industry, is also growing apace; in fact, the demand for the better grades of ore exceeds the quantity offered by miners.

PRACTICAL ASPECTS OF STEAM RAILROAD ELECTRIFICATION.*

By W. N. Smith.
(Concluded.)

We now come to a phase of the question which in the writer's opinion is probably the most complicated and least understood of all; namely, the standpoint of the railroad operator or transportation superintendent, and his organization, upon whom the railroad depends for maintaining its earning power. It hardly need be said that the transportation man has it in his power either to make or mar the earning capacity of a railroad, and no matter what facilities for increasing transportation capacity are furnished by the management, the duty of making them pay dividends devolves upon the operating department. The business of a railroad being primarily transportation, and transportation being the special function of the operating department, we here come in contact with the highly trained specialist, upon whom falls the burden of getting the traffic over the road, whether it be level or hilly, straight or crooked, single or double track.

It is conceded by all, that the great thing to be desired in a railroad of given proportions is capacity for train-movement. The capacity of a double-track road is stated to be in general, about four times that of a single-track road, general conditions as to grade and location being equal; but as more than seventy per cent of the railroad mileage of the country is single track, the most universal problem of increasing track capacity by electrification will apply to single-track rather than to double-track lines. This, of course, excepts terminal and suburban conditions, but includes the majority of mountain railroad conditions where double-tracking is sometimes a physical impossibility.

Engineers familiar with the interurban trolley development of the past ten years are aware that most lines of this type dispatch their trains very largely by the telephone system. Generally speaking, this method works very well, though on the more highly developed systems it is combined with some of the features that have been standardized by the rules of the American Railway Association, and adopted by practically all the steam railroads. It must be remembered, however, that conditions on trolley roads are somewhat different from those on steam roads. The vast majority of the trains are light passenger trains of one car each, stops are of shorter duration, and the speed of all trains is more nearly uniform. The distance between turn-outs is less. The penalty of a wreck due to misunderstanding or miscarriage of orders is, generally speaking, much less with the average interurban trolley road than with the average steam railroad; and trolley railroad operators are correspondingly more willing to run the risks incidental to dispensing with the system of transmission of train orders, which experience has shown to be necessary on steam railroads. The meeting points are generally much nearer together, and a block system of any kind would cost relatively more to maintain and operate in proportion to the business done than is the case with steam railroads. At least, there seems to be some such motive preventing the universal adoption of signal systems by trolley roads. In any event, it is not at all convincing to a steam railroad man to point out to him the apparent ease with which trains at frequent headway in opposite directions are handled with single-track trolley roads, as a reason why the same course should be adopted by steam railroads in order to increase the rapidity of train movements. Although it is undoubtedly true that the telephone is used extensively as an adjunct to standard methods of dispatching steam-railroad trains, railroad managers generally do not seem disposed to supersede the method developed by the use of the telegraph, except in the relatively small amount of mileage protected by automatic block signals.

*Condensed from a paper presented at a meeting of the Ithaca Section of the American Institute of Electrical Engineers, Ithaca, N. Y., Dec. 6, 1907.

Whether the telegraphic train-order system or one of the other systems of block signals be used, the rules governing the operation of trains on steam railroads are very rigid. The telegraphic train orders, emanating from the train dispatchers' office, must be signed by the recipient and the signature telegraphed back to the dispatcher, who then replies "complete" to the various operators to whom he has sent the message as fast as their replies come in. An order restricting the rights of a superior train is more rigidly safeguarded in this respect than an order increasing the rights of an inferior train; and a superior train must receive and reply to its orders before any can be given to the inferior train. Much time may be, and often is, thus consumed, which may restrict considerably the capacity of a line to handle traffic. Another rigid type of rule is that requiring an inferior train to clear the time of a superior train at a meeting or passing point by not less than five minutes. This holds whether a train-order system or a block-signal system be used. This five minutes' clearance is frequently, for special reasons, increased to ten minutes, and often to twenty minutes, thus placing the inferior trains at a still greater disadvantage. Instances of this kind occur when some especially fast express train is operated, where, to insure the greatest possible degree of safety, twenty minutes' clearance is provided. The fastest high-speed "flyers" of the present day are thus protected, to the greater safety of the passengers, but to the disadvantage of freight trains. Two such flyers, one in each direction over a road per day, will thus cut down the current of slower traffic over the whole road to the extent of at least forty minutes per day, and frequently more. If an inferior train cannot make an intended siding in time to allow for the required clearance, it is obliged to wait on a nearer siding and lose the time required for the superior train to cover the distance between the two sidings, plus any extra time which the superior train may have been delayed. One such delay is more than likely to lead to another, and so the delays pile up into hours during the run intended to be made in ten or twelve hours. If traffic is dense, and sidings far apart, such delays become very serious, and besides the delay to freight, and disappointment and inconvenience to shippers and per diem charges on cars, there is added the overtime due to the employees, which increases the operating expenses. It seems to the writer that conditions of this character are not taken into sufficient account as having a bearing on the subject of electrification for increase of track capacity; and something more than the ability to accelerate rapidly and maintain higher speeds must be given consideration in estimating the increase in the net schedule speed of train movement than at first sight may seem directly to result from the substitution of electricity for steam.

One item peculiar to steam operation which causes delays is the stopping for water. The frequency for such stops will depend both upon the weight of the train, and the grade of the road. Stopping for water sometimes adds to the delays from other causes that have previously held up a train; but for any particular problem the effects of stops for water should be considered separately from stops for other purposes. Where combined with a stop for some other purpose, no marked gain is effected by eliminating the necessity for taking water, unless perhaps three or four engines were to take water in succession.

A case was recently cited of a single-track road in a mountainous country where double tracking would be a very expensive proposition, this road having a heavy traffic in both directions, loaded ore cars coming down and empties going up. It was found in operation that the easiest way to get the traffic over the road was to make every siding a meeting point; that is to say, the road was practically full of trains. The only way of increasing traffic on such a line, other than by double-tracking, would be to increase the speed of all trains in the same proportion. This might seem feasible enough by electric motive power, but then arises the question whether the increase in speed that could be thus obtained would be sufficient to enable an increase in the daily traffic that would pay a dividend on the total cost of electrification.

ELECTRICAL CONTRACTORS' BANQUET

AT FAIRMONT HOTEL, JAN. 18, 1908

By request, because of the poor workmanship on this picture last week, we reproduce it in this issue.

BRENNAN MONO-RAILWAY.

On exhibition at the Electrical Show recently held at Chicago was a model of the Brennan mono-railway, which was described in these columns some months ago. An English exchange states that the inventor is operating a model car, 6 feet long and 18 inches wide, over a one-rail track that represents every phase of difficult ground.

The track wheels are in a single line through the center of the car instead of at the sides, as is usual, and are carried on compound bogies at either end of the car, being electrically driven by storage batteries placed in the body of the car. All the wheels are power driven, and an efficient system of brakes is also fitted. Inside the house on the car is fitted the automatic mechanism, which gives to the car its characteristic features of being able to maintain its balance whether standing or moving in any direction at any rate of speed. This consists of two heavy fly-wheels, rotated by electricity in opposite directions. These wheels are mounted so that their gyrostatic action and stored energy can be made use of. Mounted on high-class bearings to reduce the friction at the journals as much as possible, the power required to keep them in motion is very small. The work stored up in the wheels is so great, and the perfection of the bearings so good, that should anything happen to the driving machinery the wheels would continue to revolve for quite a long time, in the case of the model car long enough to keep it stable while it was running all round the grounds; in a full-sized car for some five or six hours. Provision is made for the safety of the car by the fitting of two legs, one on either side, which can be lowered very easily and quickly. The power for driving the car need not, of course, be electrical; any type of motor is suitable, either steam, gas, petrol, or electrical, as local conditions permit. The rail which the car runs on in the grounds is of circular section, but for ordinary work would be of the same type as that at present used, and would only require to be of the same weight to carry the same load on the same number of wheels. Sleepers need only be half the length as now in use. In war time, for conveying of troops and war material, the system offers exceptional advantages, as flying tracks could be laid over most difficult grounds, and when bridges had been blown up or otherwise destroyed, all that would be required to safely cross a river would be steel wire hawsers of sufficient strength, and safely anchored and drawn taut on either side of the stream. One of the strangest points about the wire bridge is that the car is more stable on the wire than on the ground, due to the fact that as the car sways the wire sways with it, and the lines of disturbing forces and righting forces are more readily equalized and stability maintained.

To watch the 6-foot model taking curves whose radius was about what would be obtained by bending the rail around the knee, running along a zig-zag track, the lengths of the sides being about 1 foot and the angles about 65 degrees or 70 degrees, seemed marvelous. The car was switched onto a circular track, where its wonderful righting powers were clearly demonstrated. While running at a considerable speed, weights representing from 1 to 3 tons were taken from the center of the car and placed on the outside edge, the result being that, instead of dropping towards the side the weight had been placed, it acted in the opposite manner, and raised itself on that side just as a man would throw up the shoulder he was carrying a weight on to bring himself into a stable position again. It was run up an incline of one in five. The car having been run around the grounds was then put on a track leading to a wire bridge, which was stretched across a span of some 50 or 60 feet, having an incline of one in eight, and about 6 feet or so off the ground. The car was run backwards and forwards over the bridge, and its perfect safety made the more certain to those watching by the inventor's assistant engineer, whose weight was something like 10½ stone, taking a seat in the car and making several journeys across the wire, as well as stopping in the center of the span. The weight of the engineer represented to scale some 32 tons, and the center of gravity of the car while so loaded must have been abnormally high.

The Indian Government has granted £6000 for the building of a large car, and, in addition, the War Office has granted the use of the Brennan Torpedo Factory, as well as the use of the land adjoining, for still further carrying on the work.

BATTLE CREEK POWER LITIGATION.

On February seventeenth, at Redding, California, is to be tried a riparian rights case that will be of direct concern to all interested in the development of hydro-electric power propositions. The question is contested between the Pacific Power Company and the Battle Creek Power Company, a subsidiary of the Northern California Power Company, as to who is the lawful owner of the water rights of Battle Creek. It seems that twelve years ago these rights were located by the Mt. Lassen Water Company, who, foreseeing their value, but being unable at the time to properly develop them, set one man at work breaking trail, piling stones and in other ways as they supposed complying with the letter of the law. But this guardian of the property being obliged to leave the claim for a longer period than the law allows, these claims were jumped by the Battle Creek Power Company, assuming that there was no representative of the Mt. Lassen Company on the property They pursued the same "dog-in-the-manger" tactics. In the meantime, the representative of the Mt. Lassen Water Company returned from his visit to San Francisco and prosecuted his work also.

But, unheedful of the means by which new title had been claimed, the Battle Creek Power Company's agent left his work to build a house on a homestead claim. Whereupon the Pacific Power Company appropriated the rights and set thirty-five men at work digging ditches. They had already bought a large tract of land from private parties for a power plant site, and to secure title had bought out the claim of the Mt. Lassen Water Company, the original locator.

Meanwhile, the Battle Creek Power Company had come under the control of the Northern California Power Company, and work was started on a dam whose overflow would flood the power plant site of the Pacific Power Company with ninety feet of water. Condemnation proceedings were instituted by the Battle Creek Power Company, who claims to be the owner of the water rights. This is the case to be tried.

As the outcome of this case will greatly interest hydro-electric engineers, the "Journal" hopes to publish the final decision in full. From an independent standpoint, we deplore this policy of endeavoring to keep just within the letter of the law and retard legitimate development which other parties are anxious to pursue.

APPROVED APPARATUS.

FIXTURES.

Morse adjustable fixtures for mounting on benches or side walls. Cat. Nos. 1 to 5, inclusive. Approved Jan. 3, 1908. Manufactured by

Frank W. Morse, 516 Atlantic Ave., Boston, Mass.

FLEXIBLE CORD, PORTABLE, FOR ELECTRIC HEATERS.

Double or triple conductor cords composed of braided conductors with rubber and asbestos coverings, the several conductors separately protected by woven cotton braids and enclosed by an outer glazed cotton covering. Approved Dec. 31, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

WIRES, RUBBER COVERED.

Marking: Green and black thread parallel in braid. Approved Dec. 31, 1907. Manufactured by

W. R. Brixey, 203 Broadway, New York City.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to The Journal of Electricity, Power and Gas," Weekly.

VOL. XX FEBRUARY 1, 1908 No. 5

EDITORIAL.

High-Efficiency Lamps And The Central Station.

At the beginning of this year came the announcement of leading incandescent-lamp manufacturers that they had for sale a practical tungsten lamp. This announcement is fraught with far more importance than appears at first sight. It is the culmination of a long series of painstaking experiments in the face of great difficulties. It is but one of a large number of attempts to produce a more efficient source of incandescent lighting than the old carbon filament. The first of these to attain commercial success was the graphitized filament or Gem lamp, which gave 326 candlepower-hours per kilowatt hour as compared with 236 given by the ordinary carbon filament. The Nernst lamp, giving 307, is not included in this discussion, nor are the various arc lamps. Next came the 44-watt tantalum lamp, which gives 364 candlepower hours per kilowatt-hour. Finally we have the tungsten lamp, which in recent experiments has been found to give 617 candlepower-hours. In the course of these experiments it was shown, in a paper read by Mr. Arthur J. Sweet before the Pittsburg section of the American Institute of Electrical Engineers, that an ordinary 56-watt carbon filament incandescent lamp rated at 3.5 watts per candle and 16 horizontal candlepower gave 13.2 mean spherical candlepower and required 4.24 watts per candle. A 60-watt, 110-volt tungsten filament at 1.25 watts per horizontal candlepower gave 37 mean spherical candlepower, requiring 1.62 watts per candle. In other words, the tungsten lamp gives more than two and one-half times the amount of light for the same current consumption.

Till now, this high efficiency has been counteracted by the high price and great fragility of the imported German lamps, preventing any extensive use. But by careful packing they may be shipped without danger of breaking. The use of spring-anchored filaments also allows them to be burned in any position. In addition, they emit a white light that renders true color values. It is also stated that the tungsten lamp, likewise the tantalum, is little affected by voltage variations and allows inherent regulation.

It will be but a short time before the public will realize these advantages of efficiency and economy and put in these lamps, as they are claimed to have an average life of 1,000 hours and are not easily burned out by the application of excessive voltages. The helion or silicon lamp, the osmium, zirconium and iridium lamps are also in the race, the former bidding fair to give the desired "one-watt-per-candlepower."

This makes clear our opening statement of the importance with which these developments are fraught, especially to the central station men. For certainly they are interested in a lamp that uses so much less current to give the same illumination. Some pessimists prophesy decreased current consumption and consequent decreased incomes. But analysis will present a more optimistic view. This is primarily based on the difficulty in the manufacture of low candlepower metallic-filament lamps. Of the two sizes advertised in this country, one consumes 40 watts to produce 32 candlepower, and the other 60 to produce 48 candlepower, which is not so very different from the common 50-watt carbon-lamp consumption. It means more light at the same cost, rather than the same light at less cost. But granting for the sake of argument that there will be a slight diminution in the amount of current used by each customer, it will allow more customers to be taken on the present overloaded circuits. Again, it will reduce the lighting peak to near the average load level, which can thus be raised without danger of the maximum exceeding a safe limit. More consumers can be added without purchase of new machinery, and with better lights many will be attracted who cannot now be induced.

But it is in the first cost of a new lighting plant that the saving will be most noticeable. Smaller generators and smaller distributing wires will supply more light to more customers than under present conditions. Interest on investment, taxes, insurance and depreciation will be materially lessened, and it will form a more attractive proposition to the investor who realizes the limitations of a high peak. Running expense of supplies and attendance will be less for the same service. So, instead of the somber outlook of reduced revenue, this blessing in disguise illuminates the trail of greater returns on every dollar invested.

SHALL WE KILL OR FEED THE GOOSE?

Considerable publicity has been given by the Welsbach Company to a cartoon entitled, "Killing the Goose That Laid the Golden Egg." Through the courtesy of the "Illuminating Engineer," we reproduce this, together with a companion picture of "Feeding the Goose," which is self-explanatory to our central station readers. But these two cartoons are also indicative of what has been done in many other business lines whose watchword is "retrench." Some managers who now say, "I cannot afford to advertise," two years ago said, "I do not need to advertise." Then they were engulfed in the great wave of prosperity that filled their shops with more than they could handle. Now, when threatened with the reactionary wave of business depression, they neglect the one bulwark that will stop its course and store up business for them on a safer and saner level. The flood tide of renewed confidence is returning, and the wise man is preparing for it in this temporary lull.

With a meritorious article, there are but two fundamentals for business success: to find the market and to properly exploit it.

Today's biggest market is the rapidly growing territory west of the Rocky Mountains. It suffered less in the recent bankers' panic than any other section of the country. It is a producer of raw material even while it is the greatest consumer of your manufactured product. It is a lender, not a borrower. Fruit, grain, lumber and mineral we sell. The money this brings us we spend for improvements. These basic products have given us the financial soundness that induced Eastern capitalists to advance $5,000,000 for the reconstruction of the United Railroads in San Francisco. This is but one instance of the millions in money that are to be expended in the power development of the West. Surely your product will be necessary in the work.

To exploit it, is there anything better than a technical journal that for fifteen years has summered and wintered with the engineer and contractor in the Western camps; that is read from cover to cover because it tells what he and his are doing, and that has earned his regard and confidence by long-tried test? The men who first advertised to make their house and their goods well known among prospective customers are today selling goods to our readers. One of the most successful supply houses in the West is universally credited with having gained and held its prestige because of its extensive and persistent advertising in our columns. You can do likewise and thus smooth the way for your salesmen and shorten the time necessary to get acquainted, by advertising. What advertising is doing for your competitors it can do for you. Our readers and buyers believe that nothing but the best is advertised. Can you afford to stand the comparison when not represented?

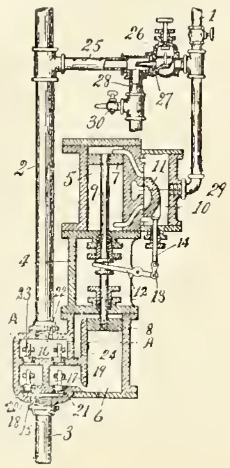
There is a further point in connection with this whole matter of advertising that deserves to be noted, viz., the close attention given the advertisements appearing in a technical journal. No matter how well the contents may be prepared, that portion of it represented by the announcements of prominent and progressive business men is by many readers deemed to be the most interesting. In the Editorial section there is always present the possible element of academic opinion. This is eliminated in the advertising assertions in the technical press. This part of a technical journal always affords the surest index of what may be styled the present state of the art. All that is therein claimed is entitled to the fullest measure of confidence, as it is the result of exact, costly and long-continued trial. The manufacturer of electrical machinery does not make his customers pay for his experiments; he has trial tests of his devices oft repeated till the standard of perfection is attained as nearly as possible, and then he makes public announcement in the advertising columns of what is necessarily the newest in his lines. What he says is not theory or supposition, but may be relied on as being authentic, for he cannot afford to do otherwise. Hence it is that there is great truth in the remark of a reader that in the advertising columns he finds the latest electrical news, and consequently reads them first.

And, having tried the remedy, do not use it intermittently. A car that is started and stopped, and started and stopped, doesn't get there as soon as the one that runs right along. Not only that, but it wears out sooner, as the wheels and brake shoes are worn away and the cars racked by this disinclination of matter to stop. "Keeping everlastingly at it brings success."

PATENTS

PUMP OPERATED BY COMPRESSED AIR. 876,849. Danvill W. Starrett, San Francisco, Cal.

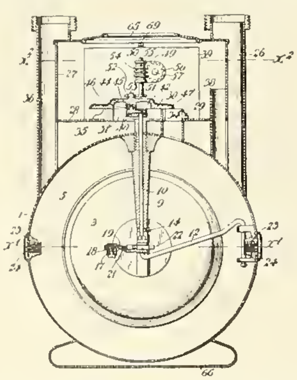
In an apparatus of the character described, the combination of a compressed air pipe, a water discharge pipe, a chamber at the bottom of said water discharge pipe having two lower compartments each having an inlet valve therein, a cylindrical pump, the opposite ends of which connect respectively with said compartments, a compressed air cylindrical motor having a pis-



ton substantially equal in diameter to the pump piston and connected therewith to move in unison, said compressed air motor being connected with the compressed air pipe to be operated thereby, an upper compartment having check valves communicating respectively with the lower compartments, said upper compartment also communicating with the water discharge pipe, and a passage from the compressed air pipe to the water discharge pipe sufficiently large to distribute the air through the latter pipe so as to reduce the weight of the water upon either of said check valves below the compressed air pressure, whereby the pump can operate under said compressed air pressure to force water therethrough, substantially as described.

GAS-METER. 876,875. Thomas Henning, Charles E. Henning, and William J. Henning, Pasadena, Cal.

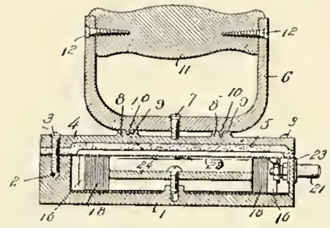
In a gas meter, the combination with the gas pressure operated shaft, provided with an adjustable crank, a rotary



valve operated by the crank, another shaft having crank connection to the valve member to be operated thereby, a worm and detachable means for securing it to its shaft, and a dial operating worm wheel engaging said worm.

ELECTRIC SAD-IRON. 876,639. Williard M. Harwood, Ontario, Cal.

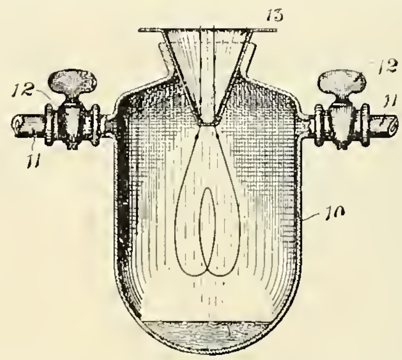
In a device of the character described, a body, cores therein, insulating material covering the cores and wires wound upon said insulation and extending substantially the entire length



thereof to bring the same well into the toe of the body and means connected to the bottom of the body and pressing laterally against said cores to keep them in place.

PROCESS OF MAKING ELECTRIC LAMP FILAMENTS. 876,331. Walter G. Clark and Herschel C. Parker, New York, N. Y., assignors to Parker-Clark Electric Company, New York, N. Y.

The process of making filaments for incandescent electric lamps, which consists in heating a filament by passing an elec-



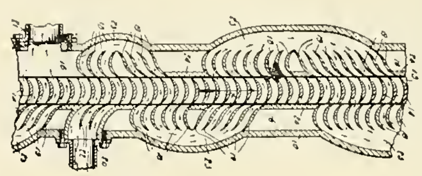
tric current through it in an atmosphere containing marsh gas, olefiant gas, carbon dioxide, and a substance containing silicon, whereby we secure the following reaction:

$SiCl_4 + CH_4 + 4C_2H_4 + CO_2 = Si + 4(C_2H_5Cl) + 2(CO)$.

The silicon being deposited on the carbon filament.

STEAM-TURBINE. 876,530. Frederick A. Douse, Seattle, Wash.

In a steam turbine, in combination, a casing having inlet and outlet openings and having annular chambers in each side provided with recesses, a wheel rotatably mounted within the casing and provided with a rim, buckets of concave-convex form disposed on said rim with their convex surfaces disposed in the direction of rotation of the



wheel, a band secured to the outer extremities of the wheel buckets, a plurality of blades of substantially crescent shape and a plurality of blades of compound curved contour arranged in said annular chambers, the said different types of blades arranged in groups of successively increasing numbers in each chamber, the said blades of crescent shape disposed to present the convex faces opposite to the direction of the wheel and the other blades arranged in diagonal planes with their inner edges disposed in the direction of the revolution of the buckets.

INDUSTRIAL

FREQUENCY CONVERTER SET.

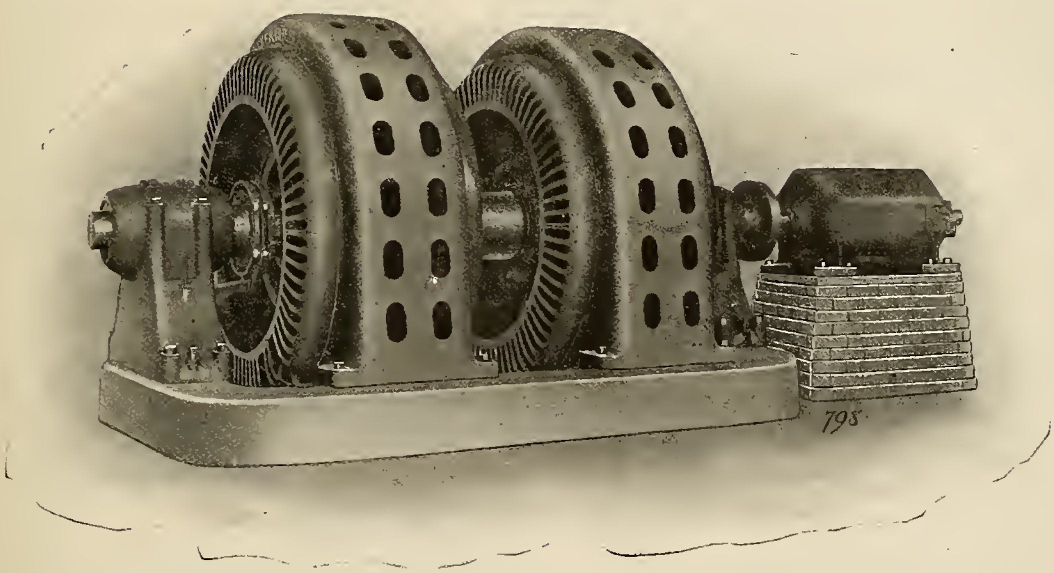
The various frequencies employed in alternating current work, though each adapted to the particular service required often lead to complications where it becomes necessary to combine the services from two systems of different frequencies; for example, when a 25-cycle isolated power plant becomes overloaded and it is necessary to purchase power from a public lighting service of 60 cycles.

In direct current work, the same trouble might arise from difference in voltage, were it not that direct-current voltages have been thoroughly standardized in this country. All direct-current power apparatus is designed for 230 volts, which is supplied by any direct-current central station. Even if 115 volt lighting current is required it can be readily furnished from a 250-volt system by means of a small rotary balancer of about one-tenth the capacity of the power required.

In changing the frequency of alternating-current supply, however, it is necessary to have two machines, each of the full capacity of the power transformed. In transforming a service of 60 cycles, for instance, to 25 cycles, a 60-cycle motor is required, driving a 25-cycle generator.

Frequency converters are also of use in sub-stations of long-transmission lines. Low frequency is desirable for alternating-current transmission, both for regulation and power factor. High frequency, however, is required for lighting distribution. A frequency converter, therefore, can be conveniently used at the sub-station to change the low frequency of the current received from the distant generating station to high frequency for local lighting. A number of frequency converter sets have been built for this purpose by the Crocker-Wheeler Company for the Shawinigan Falls Water, Light & Power Co.'s Montreal station.

The accompanying illustration shows a frequency converter of 1,000 K. V. A. capacity, installed in the plant of the Pennsylvania Steel Co., Steelton, Pa. The 25-cycle power plant of this company became too small to carry the full load of the plant. This C.-W. frequency converter set was therefore installed to utilize the 60-cycle service of the York Haven Power Company during the hours of heavy load.



1000 K. V. A. 60/25 CYCLE C-W FREQURNCY CONVERTER.

The set consists of two Crocker-Wheeler machines mounted on a heavy shaft, and a starting motor.

The motor unit is a fourteen-pole, 1,150 K. V. A. machine, and the generator unit is a six-pole machine. The change in frequency is therefore 60 cycles to 25.7 cycles. The starting motor is a Crocker-Wheeler direct-current, Form "W" rolling-mill motor, having enormous starting torque and specially designed for short runs at very heavy loads. The starting motor is used only to bring the set to synchronism at 514 revolutions per minute. The well-known ability of Crocker-Wheeler alternating-current apparatus to operate in parallel makes the synchronizing of the set a simple matter.

The set is usually employed to carry a part of the load of the plant independently of the company's power plant. In emergencies, however, the plant is thrown in synchronism with the 25-cycle end of the set.

CHICAGO FUSE WIRE & MFG. CO. ELECTRICAL SHOW EXHIBIT.

The accompanying picture shows the exhibit of the Chicago Fuse Wire & Mfg. Co., at the Third Annual Electrical Show given by the Electrical Trades Exposition Company, at the Coliseum, Chicago, Ill., beginning January 13. This exhibit attracted the attention of the practical men by its attractive and comprehensive showing of the wiring contractor's needs. One display board was devoted entirely to

"Union" enclosed fuses, both old and new code. Another showed the construction and mechanical perfection of "Union" switch boxes. The next displayed "Union" enclosed fuse blocks, N. E. code. Fuse wire, fuse strip and fuse links were arranged on another board, while on the one adjacent appeared "Union" conduit outlet boxes and covers, round and square. The remaining board had a combination of enclosed fuses and blocks, also of "Union" make. The sales representative, Arthur S. Merrill, had charge, being assisted by Geo. C. Reid and Walter D. Dana. As a whole, the exhibit of the Chicago Fuse Wire & Mfg. Co. elicited considerable favorable comment.

TRADE CATALOGUES.

The January "Holophane" contains its usual quota of correct principles of scientific lighting, together with typical illustrations for all classes of service.

"Common Sense," from the Electric Controller & Supply Co., of Cleveland, Ohio, is a new magazine "devoted to fundamental democracy, humor, and industrial and commercial sociology." It is good reading.

"Linolite," from H. W. Johns-Manville Co., describes a modern system of lighting, employing a continuous, semi-circular reflector with long tubular incandescent lights. It is particularly adapted for window and picture lighting.

The Northern Electrical Manufacturing Co., of Madison, Wis., sends a booklet on "Variable Speed Motors," which contains some interesting facts about the single voltage variable speed system. This employs regulating poles and coils to give a shunt field control.

KOERTING OIL-FIRING SYSTEM ON JAPANESE STEAMER.

The Toyo Kisen Kaisha Steamer Soyo Maru at present in San Francisco Bay, is attracting a large number of visitors on account of the peculiar oil firing system. She was built in England and is fitted with the Koerting system of oil firing. The oil with a gravity of 16 to 17 degrees Baume and kept under 40 pounds pressure is superheated to 220 degrees F. and leaves the Koerting centrifugal spray nozzles perfectly mixed with air so as to give complete combustion. It is obvious that this system using neither air nor steam to spray the oil from the burners is superior to many of the present methods, as there is such a great saving of steam. These results show that apprehensions regarding the carbonization of fuel oil wtth asphaltum base are groundless. The Schutte-Koerting Company of Philadelphia have just issued their new catalogue No. 6, Section O, which will be of interest to all large fuel oil consumers. O. C. Goeriz and Company of San Francisco are the Pacific Coast representatives.

The Westinghouse Electric & Manufacturing Co. is now distributing a well-written treatise on alternating-current and direct-current integrating wattmeters. Not only the mechanism and construction, but also the principle on which the meters operate, is fully described. A large number of illustrations showing the various parts of the meters will be helpful to those interested in meter design, and a complete set of connection diagrams should be of great assistance to those called upon to install meters on the various classes of commercial circuits. A well-arranged index is supplied to assist in clearly locating any particular subject covered by the circular.

PERSONAL.

George Beardslee, Secretary of the Beardslee Chandelier Mfg. Co., of Chicago, was in the city for a few days the past week.

Robt. McF. Doble, consulting and supervising engineer, has moved his office from Colorado Springs to 529 Majestic Building, Denver, Colo.

Arthur Williams, of New York, has accepted the chairmanship of the committee on public policy of the National Electric Light Association. W. H. Gardiner, 60 Wall Street, New York, will continue to act as secretary of the committee.

George Moraine, who has been general superintendent of the Ben Hur Interurban Company in Crawfordsville, Ind., has handed in his resignation, to take effect February 1st. Mr. Moraine will engage in the electrical business on the Pacific Coast.

A recent patent provides for the lighting of harbors subaqueously. A cable connected with a source of electric supply is laid along the bottom of the harbor, and to it are attached incandescent electric lamps equipped with parabolic reflectors, which will mark out the course of the channel by brilliantly lighted spots on the surface of the water. In foggy weather this beam of light would be particularly useful in guiding a vessel.

NEWS NOTES

FINANCIAL.

San Francisco, Cal.—A special meeting of the Bay Shore Water Company will be held in this city on January 30, to act upon a proposition to dissolve the corporation and wind up its affairs.

San Francisco, Cal.—Last week the Board of Supervisors passed to print a declaratory ordinance for the issue of bonds to the amount of $32,000,000. A portion of the proceeds of these bonds is to be used for the construction of an auxiliary water supply system for fire protection.

San Francisco, Cal.—The State Supreme Court has decided that the San Antonio Water Company, which has developed water in San Antonio Creek by sinking wells in the bed of the creek, is entitled to the use of these waters without dividing with the Pomona Land & Water Company, which has a claim on the surface waters of the creek.

Vallejo, Cal.—The Board of Trustees and Board of Works of this place have decided to call an election to decide on a proposition to issue bonds to the amount of $80,000, the proceeds to be used for the construction of a second reservoir in the Wild Horse Valley for the municipal water system. The proposed reservoir will hold 600,000,000, and will be located fifteen miles from this city.

Los Angeles, Cal.—The city of Los Angeles has won its suit in the matter of the license tax of $100 per month levied against the Los Angeles Independent Gas Company. The Supreme Court holds that, though the business of the company amounts to only $1,500 per month, while the business of its rival amounts to many times that amount, the ordinance cannot therefore be held discriminating and unconstitutional.

Los Angeles, Cal.—The Supreme Court of the State has decided in favor of the city in the matter of the ownership of the water of the Los Angeles River, which was contested by the Los Angeles Farming & Milling Company. The court held that the city, as the successor of the old Mexican Puebla of Nuestra Senora Reina de Los Angeles, was entitled to the water of the river through the treaty by which California became a part of the United States.

TRANSMISSION.

Dinuba, Cal.—The San Joaquin Light & Power Company is figuring on the stringing of a power line from this place to the Stone Corral country.

San Diego, Cal.—P. F. Schaniel and E. W. Jones have secured a franchise to develop electricity from the tide waters of False Bay, in this county.

Las Vegas, Nev.—E. H. Syphus and Levi Syphus, of St. Thomas, Nev., have made application to be permitted to appropriate the waters of the Spring and Rio Virgin Rivers for power and mining purposes.

Yuma, Ariz.—A. W. Womble states that if the Government will grant him water rights on the Colorado River he will build a 1,000-horsepower electric plant from which a transmission line will be run to a proposed mining mill at Kofa, in the King of Arizona district.

Oroville, Cal.—Warren Sexton, acting for the Great Western Power Company, has applied to the Board of Supervisors of this county for a franchise for an electric transmission line through the county. The line will carry 100,000 volts, the cables being suspended from steel towers 130 feet high.

Honolulu, T. H.—Jas. A. Coke, of Maui, is now in Washington, looking after a movement to secure a franchise for the installation of a power plant on Maui. The plant, for which it is hoped the franchise will be approved by the present Congress, is to supply electricity to the towns of Lahaina and Kahului, and to a number of plantations.

Oakland, Cal.—E. M. Downer, of Pinole, representing the Great Western Power Company, has been awarded a franchise by the Board of Supervisors for the erection of transmission lines along the roads of the county. The franchise will run for fifty years and under its terms the company is to pay into the County Treasury two per cent of the gross receipts from the current passing over the lines operated under it.

TELEPHONE AND TELEGRAPH.

Los Angeles, Cal.—The Home Telephone Company will, on February 21, remove its principal office from this city to Chino.

Vallejo, Cal.—Navy yard officials announce that a wireless station is to be installed at Valdez, Alaska, in addition to the one already operating at Sitka.

Willows, Cal.—The Glenn Telephone Company, of this place, has contracted with the federal government to construct from Orland to Sites, by way of Stony Ford.

Santa Rosa, Cal.—The Rincon Valley Association has been organized at Rincon Valley, for the purpose of having a telephone line built into that section. A. Bacon is president, and L. M. Bush, secretary of the association.

Salina, Utah—The Salina Telephone Company has been organized here, to construct and operate a telephone system in this place. A franchise has already been secured. A. J. Lewis is president, and H. F. Jorgensen, secretary of the company.

Oakland, Cal.—The Home Telephone Company has applied for permission to extend its lines throughout this county. A fifty-year franchise is asked, in return for which the company offers to make a number of concessions, including free telephones for the county officials and two per cent of the gross receipts.

ELECTRIC RAILWAYS.

Stockton, Cal.—Bids will be received to February 10, for the electric street railway franchise in this city, applied for by the Central California Traction Company.

El Paso, Tex.—T. B. Enocks and others, of Kansas City, Mo., are planning to build an inter-urban electric line between this city and Las Cruces, N. M., and are to arrive here shortly to consider the details.

Pomona, Cal.—W. C. Kerchoff is securing rights of way from Upland through Claremont to North Pomona, for an electric railway, and promises that construction on this line will begin as soon as the right of way is complete.

Chehalis, Wash.—The Chehalis & Centralia Railway & Power Co. has purchased the power plant, cars, rails, etc., of a defunct California electric railroad and will move everything and install the line—ten miles—between Chehalis and Centralia.

Phoenix, Ariz.—General Agent Landis, of the Phoenix & Eastern Railroad, states that floods have made it necessary for the railroad company to build a trolley line across the Gila River, at Winkleman, for the purpose of transporting ore.

Los Angeles, Cal.—On February 1, Wells Fargo & Co. will take over the express business on the electric railway lines of the Los Angeles-Pacific system, connecting Los Angeles with Santa Monica, Ocean Park, Redondo and a number of smaller towns.

Colville, Wash.—Application has been made to the County Commissioners by A. E. Baldwin and C. J. Webb for an electric railway franchise over the highways in Stevens County between Kettle Falls and the mouth of the Spokane River. The line will be forty-five miles long.

Eugene, Ore.—A deed was filed for record at the court house January 17th, by which the formal transfer of the Eugene and Eastern Electric Railway became the property of the Portland, Eugene and Eastern Railway. It was signed by J. O. Storey as president, and E. W. Hall as secretary. The consideration is $505,400.

San Francisco, Cal.—The Parkside Transit Company has completed track-laying on its franchise from Ingleside to Thirty-third Avenue and T Street. Work will now begin on the remainder of the main line on Twentieth Avenue, from T to H Street and on the extension of the Ingleside line from Thirty-third Avenue to the beach. The company has applied for a franchise on Twentieth Avenue, from W to H Street, to be used in place of the line previously authorized on Nineteenth Avenue.

San Francisco, Cal.—John J. Egan, who is at the head of the movement to make it possible for individuals or companies to operate street cars over thirty-one blocks of a rival corporation's tracks, has filed a petition with the Election Commissioners asking that an amendment to that effect shall be voted on at the next election. At present the limit is ten blocks. In his petition Mr. Egan states that 247 miles of street railway are desired by him and his associates. The petition contained 12,000 signatures.

Minneapolis, Minn.—An Associated Press report says: Minneapolis and St. Paul are to be the eastern terminus of an electric line to run to Seattle. The company behind the project is known as the Minneapolis, St. Paul and Seattle Railway Company, with a capital of $500,000,000. Articles of incorporation were filed with the Secretary of State at Pierre, S. D. The incorporators are William C. Webster, Rochester, Minn.; David Philips, Mazeppa, Minn.; Samuel E. Phillips and James Mosep, St. Paul, and Glenn W. Martens, Pierre, S. D.

Pasadena, Cal.—Horace M. Dobbins, president of the Pasadena Cycleway Association, announces that he is now at the head of a company capitalized at $5,000,000, which purposes the construction of an electric railroad between Los Angeles and Pasadena, which will be three miles shorter than the present Short Line of the Pacific Electric Railway Company. According to Mr. Dobbins, about $2,500,000 will be spent on the building of the road. A third-rail system will be employed. It is planned to have the electric trains make the trip between the two cities in fifteen minutes.

Pendleton, Ore.—The railroad war between Harriman and Hill seems likely to give Pendleton and the western portion of Umatilla County an electric line much sooner than has been expected. The efforts of the O. R. & N. Company to block the building of a spur track to the Peacock flouring mill at Milton by the Walla Walla Traction Company has embittered this war, and the traction company, which is a feeder of the Hill lines, now declares that it will extend its lines to this city in the next two years. It also declares that it will build to every important town and city in the inland empire now touched by the O. R. & N. Company, and a genuine railroad war and campaign of traffic hunting is anticipated in this section.

ILLUMINATION.

Sausalito, Cal.—Robert P. Geer, and others of this place, have plans under way for the construction of a large gas plant to supply gas for light and fuel.

Solomonville, Ariz.—C. B. Jameson is now negotiating with the towns of Solomonville, Pima, Thatcher and Safford, for franchises for electric distributing systems. He says that he will put in a power plant, either at Thatcher or Safford.

Los Angeles, Cal.—An ordinance has been passed by the City Council ordering the necessary appliances and current for the lighting for two years, of Fourth Street, from Main to Hill.

THE
Journal of Electricity, Power and Gas
WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

Volume XX. SAN FRANCISCO, CAL., FEBRUARY 8, 1908 No. 6

REHABILITATION OF SAN FRANCISCO'S STREET RAILWAY SYSTEMS

By ARTHUR H. HALLORAN

So rapidly have the scars left by the great San Francisco earthquake and fire of April 18th, 19th and 20th, 1906, been healed, that already even the men who passed through those trying times are forgetting the wonderful deeds accomplished in the face of impending disaster. The comment on the heroism and courage of that stricken people in one of the greatest disasters of modern civilization, has been world wide. To-day, less than two years after, the new city bids fair to outstrip the old in the magnificence of its buildings and in the growth of its population. Most of this work has been permanently recorded in the current literature of the times, but the herculean task undertaken by the various street railway companies of San Francisco in rehabilitating and extending their wrecked car lines, remains unnoticed by the public, whose convenience is sought by these companies.

As the telling of these tasks will consist largely of an account of power-plant rebuilding and track construction, it seems fitting that this electrical journal acquaint street-railway men throughout the world with the details of how it was accomplished.

The general scheme of the article will be, first to outline the conditions prevailing before the fire, briefly recount the damage done, and then detail the work of reconstruction.

The development of street railways in San Francisco has been coincident with needs of a rapidly-growing city, from a few lines of horse-cars along the level streets to a great system of cable and electric roads. To Hallidrie is due the credit of leveling San Francisco's many hills by means of cable traction; that is to say, though the hills remain in their beauty and sightliness, the cable renders them readily accessible. Subsequently, with improvements in electric motors, electric traction has been used in all new work, and in reconstructing old lines where the hills were not too steep to be negotiated by electric cars. Naturally,

WASHINGTON AND MASON ST. POWER HOUSE AFTER FIRE.

after the fire, economical considerations were also a factor in this change, not so much because of track conditions as because of the enormous cost of immediately rebuilding the cable plants that were destroyed in the catastrophe.

There were four independent systems in operation before the fire. First, and most extensive, was the United Railroads of San Francisco, which, in 1902, had consolidated the Market Street, the San Francisco and San Mateo, the Sutter Street and the Sutro Electric Railway Companies under one management. Their lines included both cable and electric, and covered most of the San Francisco peninsula. The California Street Cable Railway Company operated cars on California, Hyde, Jones and O'Farrell Streets, from a central cable power house on California and Hyde Streets. Union Street, from the Presidio to the ferries, was served by an independent company, with a cable line. Pt. Lobos Avenue and Geary to Market Streets, was operated by the Geary Street, Park and Ocean Railroad Company, from a power house on Geary and Buchanan Streets. The equipment and reconstruction of each of these will be described separately.

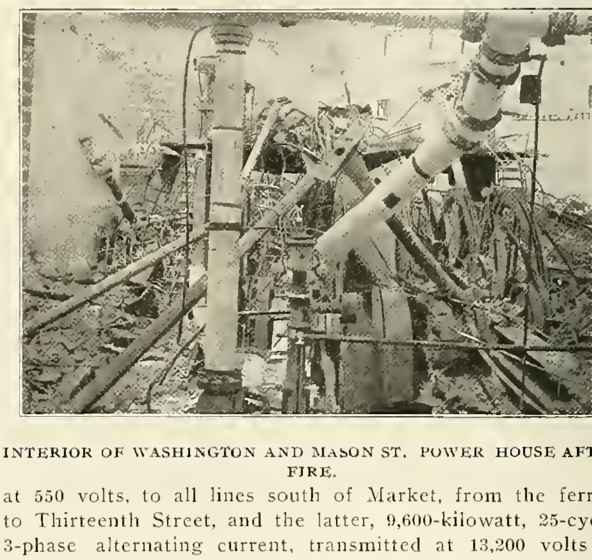
WASHINGTON AND MASON ST. POWER HOUSE BEFORE FIRE.

There were five cable power houses under the control of the United Railroads before the fire. That on the corner of Sutter and Polk operated two lines—Sutter Street, from Presidio Avenue to Market, and Polk and Larkin, out Pacific Avenue and down Ninth Street. From the Mason and Washington power house was handled all the traffic on the Sacramento, Clay, Washington, Jackson and Powell Street lines, over the steepest hills in the city. The Market Street lines, with their extensions on Haight, Valencia and Castro Streets, were controlled from the Market and Valencia Street power house. The Hayes and McAllister Street branches were each taken care of by separate stations. These power houses all consisted, essentially, of a large steam-driven reel, on which was wound a one and one-half-inch endless steel cable. Many of them also had accommodations for storing and repairing the cars, but were supplemented by several car-barns, near the line terminals. In all, there were fifty-four and one-half miles of cable road in operation.

But, whereas these cable lines had been one of the most important assets taken over from subsidiary companies by the United Railroads at the time of purchase,

SUTTER AND POLK ST. POWER HOUSE AFTER FIRE.

yet all their extensions and improvements had been with the more modern electric systems. Much of the power for these lines was taken from the high-tension lines of the California Gas & Electric Company, transmitted from their various hydro-electric plants in the Sierra Nevada Mountains. The 12,000-kilowatt gas-engine plant at Martin Station served as an important auxiliary. In addition to this, the railway company itself operated the Bryant Street and North Beach power plants. Both of these were steam-driven, the former furnishing 4,000-kilowatt direct current



INTERIOR OF WASHINGTON AND MASON ST. POWER HOUSE AFTER FIRE.

at 550 volts, to all lines south of Market, from the ferries to Thirteenth Street, and the latter, 9,600-kilowatt, 25-cycle, 3-phase alternating current, transmitted at 13,200 volts to the several sub-stations throughout the city for conversion. These sub-stations were three in number, being located at Turk and Fillmore Streets, Geneva and San Jose Avenues, and Millbrae. All lines north of Market Street were supplied with power from the sub-station at Turk and Fillmore Streets, while all south of Market, and beyond Thirtieth as far as the cemeteries, were fed from that at Geneva and San Jose Avenues. The Millbrae station

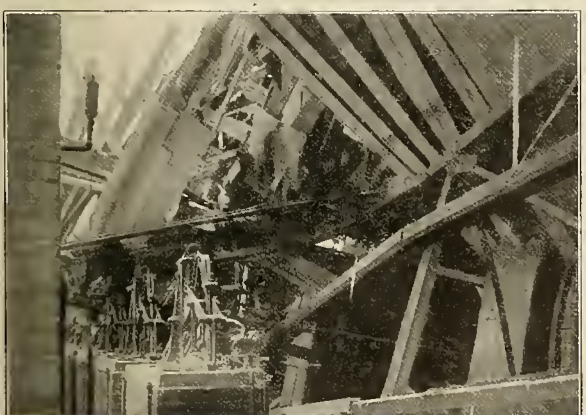
handled the suburban lines from the cemeteries to San Mateo. The total length of electric construction was two hundred miles.

From Martin Station the California Gas & Electric Corporation furnished power at 13,200-volt, 25-cycle through two lines to the Geneva Avenue station, which was in turn connected with the Turk and Fillmore Street station and

TURK AND FILLMORE SUB-STATION.

the steam plant at North Beach. Similar lines also ran from the Martin power house to the Bryant Street station, also connected with the Geneva Avenue and Turk and Fillmore sub-station.

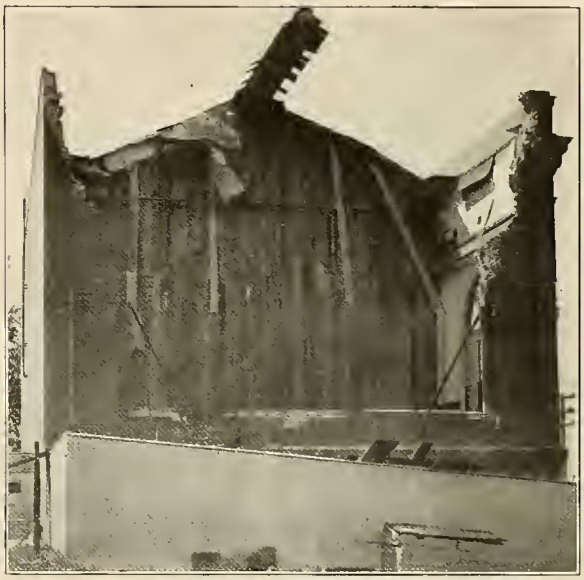
The Turk and Fillmore Street sub-station was equipped with six 10-pole, 750-kilowatt, 600-volt, compound-wound



OIL SWITCHES AT NORTH BEACH POWER HOUSE.

rotary converters; eighteen 25-cycle, 13,200-440-volt air-blast transformers, and three blower sets with 50-inch blowers. Of the ten motor-controlled oil switches, six were connected with the rotary converters, two to the incoming and two to the outgoing lines. The Geneva Avenue station had three 6-pole, 500-kilowatt, 600-volt, compound-wound rotary converters, nine 25-cycle, 185-kilowatt, 13,200-440-volt air-blast transformers and two 50-inch blower sets. The Millbrae system was equipped with two similar converter and transformer sets. All were equipped with an up-to-date system of switch-board control.

On April 17, 1906, with the facilities just briefly detailed, the company was operating 433 cable cars and 425 electric cars, having 2,500 employees on its pay roll. The executive and engineering offices were centrally situated on the eighth floor of the Rialto Building, on the corner of New Montgomery and Mission Streets, from which radiated one of the largest systems of street railway



MILLBRAE SUB-STATION.

operation and maintenance yet devised.

On April 18, 1906, at 5:13 a. m., just as the first cars were leaving their barns, there came an earthquake shock of but a few seconds' duration, the effects of which, both immediate and subsequent, completely destroyed over one-half of this great power equipment and rendered the other

NORTH BEACH POWER HOUSE TWO WEEKS AFTER.

half entirely inoperative. The great brick stacks toppled and crashed into power plant and car barn, blocking with their debris what they had not completely crushed. Cornices and portions of the roofs crumbled under the influence of these irresistible, twisting, shaking forces, and tumbled their brick and mortar into the chaotic maelstrom. Where the power was not cut off at its source, falling poles and wires cut it off along the line of distribution. Twisted tracks twined uncertainly through the streets, in some places a subsidence of a foot or eighteen inches completely severing them. Falling chimneys and brick buildings had buried great lengths under their disintegrated ruins. Much of the rolling stock, crushed into splinters and scrap iron, was good for nothing. There was probably no single corporation that suffered so greatly in the earthquake. Most

of the damage to other industries was occasioned by the fire that immediately succeeded it. How great was this damage is shown by several of the accompanying pictures.

The tangled remains of the oil switches at the North Beach power house are only indicative of the great damage

TENTH ST. BETWEEN HOWARD AND FOLSOM.

done there. One hundred feet of the stack had careened through half the slate roof, and had been hurled, together with great steel trusses, into the delicate system of dynamos and switches. All the small piping was broken from the boilers, and one of the auxiliary oil feed-tanks badly wrenched. The economizers were entirely out of commission. Yet here, as elsewhere, the main damage was caused by the great pile of debris that blocked and choked the entrances and buried the machinery. Part of the roof at the Turk and Fillmore Street sub-

TENTH ST. BETWEEN BRYANT AND BRANNAN.

station had caved in, as had also the roof of the barn across the street. The picture of the Millbrae station speaks more eloquently than words, yet subsequently it was found that all machinery had escaped hurt except one knife switch. Similarly at Geneva Avenue the roof and some of the walls fell in. The Kentucky Street car house was badly shaken up, and eleven cars thrown into the pit. The tracks were so twisted that the cars could not be moved out until they had been repaired. At Tenth and Howard Streets the railroad building collapsed completely, and all wires were down in the street. The great generator at Martin Station was moved bodily two and one-half inches to the south. The storage holder was twisted five feet on the lower section, and twelve feet on the upper. Of the electric power stations the Bryant Street station alone was capable of furnishing current.

The cable system suffered even more than the elctric. The great brick chimneys at every station were nothing but

TAYLOR ST. BETWEEN TURK AND EDDY.

ragged stumps, whose towering superstructure had crashed through the roofs and smashed in the windows and blocked up the tracks.

The fire that then raged for two days not only destroyed much of the damage wrought by the quake, but added its own quota of destruction. From the illustration can be seen the Washington and Mason power house "before and after," in the end the building having crumbled in ruins, and the machinery converted into a tangled mass of intricately inter-

CURVE NEAR LANDS END.

laced pipe, rod, cog, spoke and cable. The engine was a complete wreck. A pile of blackened bricks had buried the Sutter Street cable machinery between the low remnants of four walls. A stack of brick and mortar marked the Valencia and Market Street power house. Nearly fifty cable cars were burned, many having been saved by pushing them by hand out of the fire zone. Even some of these were burned by further encroachments of the fire. The offices in the Rialto Building were completely gutted. The tracks in the burned district were twisted

and warped, all wooden pole supports and all eyebolt supports were gone, yet the iron poles were serviceable. The tracks along Harrison Street were entirely out of commission, as were also those on the Sixth Street and the Montgomery and Tenth Street lines.

In the aggregate, possibly the greatest damage was done to the tracks. Where they were not actually twisted and wrenched out of all semblance to their original condition by the force of the earthquake, they were rendered insecure by sinking of the ground on either side. Culverts were destroyed, and whole sections of track depressed below their former level. Debris blocked the right of way for miles. Turn-tables for the cable cars were put out of plumb, and the slots completely closed. Where fire had been, the steel was warped and burned until useless. Some of the accompanying pictures give a few instances of this damage, which was very great over many lines not mentioned.

The road beds along the Powell and Mason Streets cable lines were left in fair condition, the tracks being warped, and the slots being closed in a few places. The terminal turntables were in a sorry plight. The trolley tracks at Colma and Millbrae on the San Mateo extension were thrown out of line where filled in along the right of way. In San Mateo they were covered with debris, which was soon removed. Poles sagged, and ground gave way all along this line, which runs south along the San Francisco Peninsula, closely paralleling the zone of earthquake faulting. The line had been heavily ballasted with crushed rock, on which lay the redwood ties. A 75-lb. T-rail with cast-welded joints was used along most of the private right of way. In the redwood side pole construction those carrying high-tension wires were 7x7 inches at the top, 13x13 inches at the base, and 35 feet long, and the others 25 feet long with base 12 inches square, and 7x8 inches top. The failure was not due to poor construction, but to the great forces to which it was subjected.

The fire burned until Sunday morning, April 22nd. But long before it was put out the railway system rallied to the work of clearing the wreck and preparing for the long siege of reconstruction to follow. A commissary department was organized, and provision made for housing employes. Men were detailed to stand in the bread line to obtain food for the gangs of men who started to work almost at once, apparently oblivious of their personal losses and griefs.

The conditions thus briefly outlined were met with characteristic energy by the officials and employes of the company. By the evening of April 20th current had been turned on from the Bryant Street power house, and the following roads were completed and ready for operation as regards the overhead: Bryant Street from 11th to 26th Streets; 26th Street from Bryant to Mission Streets; Folsom Street from 16th Street to Precita Avenue; Precita Avenue, Army Street and San Bruno Avenue to Dwight Street; Mission Street from 22nd Street to Virginia Avenue; 16th, Kansas, 17th, Connecticut, 18th Streets (from Bryant to Kentucky Streets); 4th and Kentucky Streets and Railroad Avenue from Channel Street to San Mateo County; 24th Street from Howard to Rhode Island Avenue; Turk and Eddy Street from Van Ness Avenue to Devisadero Street; Devisadero from Page to Jackson, and the 16th and Fillmore line from Bryant to Broadway were also ready. On the 21st, Saturday, cars were run on the Sixteenth and Fillmore Street lines until ordered stopped by the Committee of Public Safety. The Bryant Street station furnished the power, using salt water for the boilers. In the afternoon all the cars in the 28th Street car house were taken out to San Bruno Avenue. On the same day Mission Street was clear from 16th Street to the Holy Cross Cemetery. These lines were the most important in the unburned district. At the North Beach power house there were fifty men at work on April 20th clearing the debris, and inside of two weeks' time broken steam pipes had been repaired, and the plant running, as shown in the accompanying picture.

(To be continued.)

A SINGLE-PHASE RAILWAY MOTOR.*

By E. F. Alexanderson, Electrical Engineer General Electric Company.

The various single-phase railway motors which have been developed during the past few years have been styled in general as either repulsion or as series motors.

The most prominent types of single-phase railway motors which have found commercial application are:

1. The compensated repulsion motor (Latour-Winter-Eichberg). This motor has a short-circuited armature and an extra set of brushes for producing compensation, with a view to obtaining a higher power factor.

2. The compensated series motor (Eickmeyer-Stanley-Lamme).

3. The compensated series motor with shunt-excited commutating poles (Milch-Richter). In this motor a commutating field is produced locally by coils in the stator.

The motor to be discussed in this paper is neither a series nor a repulsion motor in the generally accepted sense, but embodies the best features of both. For lack of a better name, it may be called a "series-repulsion" motor. The windings resemble those of a series motor and the armature and stator are permanently connected in series. A general diagram of the motor is shown in Figure 1. The terminal voltage of the series-repulsion motor can be selected with greater liberty than in a series motor, but not so arbitrarily as in the case of a repulsion motor.

Its advantages over the straight compensated series motor are very marked. The commutation is so radically improved that resistance leads are unnecessary and it is feasible to build the motors in larger capacities.

In its performance it resembles the series motors with commutating poles, but offers several distinct advantages over the same. Instead of producing a commutating flux locally by coils on the stator, the conductors in the armature are located in places where the desired flux will naturally exist. This arrangement simplifies the stator winding considerably. The compensating winding of the series motor is replaced by an inducing winding with twice as many turns, and the energy is introduced either in the stator alone or in the stator and rotor together. By this arrangement the starting torque is doubled for the same commutation and the same supply of current.

In the compensated repulsion motor the commutating field becomes too strong as soon as the speed appreciably exceeds synchronism, unless special arrangements are made to suppress this field locally. The motor under consideration is not limited by the synchronous speed, as the repulsion motor feature is reduced at the high speeds, and its action follows more closely the performance of a series motor; the number of poles can therefore be selected with the same liberty as in a series motor. This is of great importance for the motor characteristics, particularly in regard to weight and starting torque. Furthermore, no extra set of brushes, nor any series transformer, is required, which makes the motor equally well adapted for direct and alternating current.

The two essential conditions for perfect commutation are as follows:

1. The electromotive force of alternation of the main field should be neutralized by the electromotive force of rotation of the cross field, which is magnetized by an exciting current flowing in the armature, and serving to transfer the energy from rotor to stator.

2. The magnetomotive force of the stator should be larger than the armature reaction. The difference should be large enough to overcome the voltage due to the leakage flux. This difference is furnished by another cross field magnetized by the difference between the ampere turns of the armature and the inducing winding.

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*Abstract of paper presented before the American Institute of Electrical Engineers, New York, January 10, 1908.

These conditions can be fulfilled in a series-repulsion motor at any speed without the aid of commutating poles. Instead of creating a commutating flux artificially in a place where the commutated conductors happen to be, the conductors are located in a place where the correct flux will naturally exist. By controlling the value as well as the phase of the different fluxes as described, perfect commutation can be obtained at any speed.

Figure 2 gives a comparative diagram of the alternating voltages in the short-circuited coils of a series-repulsion motor for 25 cycles, and for the same motor when used as a series motor for 15 and 25 cycles.

Starting.

The starting of a single-phase motor is materially handicapped by the fact that the alternating nature of the main field sets up currents in the armature coils which are short-circuited by the brushes. This same difficulty is experienced in all known types of single-phase commutator motors. Although the principle involved is the same in the motor under consideration, the practical result gained by the arrangement employed is a starting torque twice as high as would be possible in a corresponding series motor for the same commutation and the same supply of current.

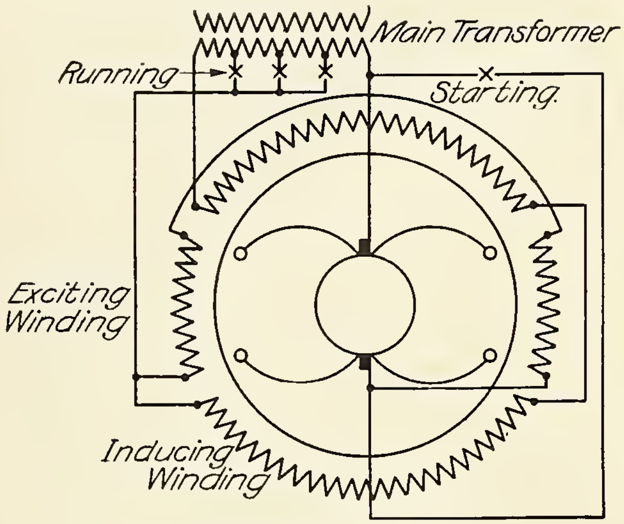


FIG. 1 THE SERIES-REPULSION MOTOR.

This double starting torque is obtained by winding the stator with twice as many turns as the armature. The motor starts as a repulsion motor with the armature short-circuited, as shown in Figure 3. The current as it enters the stator has only half the strength of that in the rotor, owing to the ratio of stator to rotor turns. The short-circuiting switch of the rotor carries only half as much current as the rotor itself, because the current in the short-circuited connection is only the difference between the stator and the rotor current. The inducing winding, the field and the armature are connected permanently in series; but with the connections shown the field is in series with the stator circuit at starting and with the rotor circuit when running. In starting, the rotor carries twice as much current as when running, in order to give the same field strength—in this manner doubling the starting torque. The sparking at starting is quite insignificant up to a certain value of the voltage short-circuited by a brush, but beyond this point the commutation rapidly becomes bad. This critical value is about the same as that which gives a reasonably good commutation in running. For a pure compensated series motor, therefore, the same remedy must be looked for in running as in starting conditions, and the natural solution is to design the motor for a low voltage or to use resistance leads.

In ordinary series motor equipments, the difficulty arises that a higher starting torque is usually required than the full-load running torque, and if the short-circuited voltage is permissible in running, it will get too high at starting. A starting torque of twice full load (one-hour rating) torque is, however, usually more than enough, and therefore the short-circuited voltages can be kept below the critical point, while the torque is increased above normal. It is, however, not only the critical value of the voltage, but also the time that such a voltage is maintained that determines what is permissible. In this respect any repulsion motor has a great advantage, because the sparking disappears altogether as soon as the armature has reached an appreciable speed. Furthermore, a voltage could be allowed in starting with a double torque which would not be permissible with normal running torque, on account of the short time-element of the starting condition.

The general principle which has been discussed for regulating the field in starting an alternating-current motor can be applied in different ways; it was first employed by Eichberg, who used a variable series transformer in the field circuit. Particular attention may, however, be called to the simplicity of the arrangement described here, where the same result is accomplished through the inherent characteristics of the motor without the use of any additional apparatus. The same principle can be applied to series motors by the use of a series transformer or some suitable controlling device, but it involves the disadvantage of doubling the current which is to be supplied to the motor through the control system, whereas when starting as a repulsion motor, increased torque is gained by local current superimposed on the main current by induction.

Control.—In regard to the practical application of the system, it may be mentioned that several four-motor equipments for alternating and direct current have been in operation for some time. The alternating-current control equipment has a total of seven contactors and a reversing switch. This gives four points

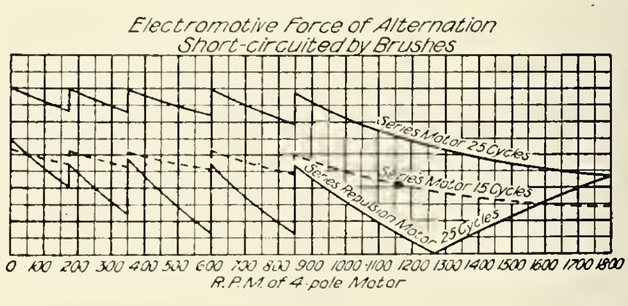


FIG. 2.

on the controller which seems quite satisfactory for motor-car operation, though any number of steps can be added to take care of locomotive operating conditions.

The preferred method of control is the one shown in Figs. 3 and 4. In starting, the armature is short-circuited and the full secondary voltage of the transformer is impressed upon the inducing and exciting windings. The current flowing through the stator continues through the armature, but due to the ratio of turns of inducing winding and armature winding, an additional current of equal strength to the stator current flows through the local circuit of the armature and the short-circuited connection. In the running connection, part of the power is introduced in the stator and part in the rotor, and the field winding carries the same current as the armature; that is, twice the stator current, thus giving a relatively greater field strength than in the starting condition, just as it would be produced by a series-multiple connection of the field winding.

Although the total potential impressed upon the stator and rotor is the same for starting and running, the result of changing the connection so as to transfer the energy input from the stator to the rotor has the effect of increasing the resulting voltage of the motor. This is due to the ratio of transformation between stator and rotor. In this manner a higher speed is obtained by impressing a higher resulting voltage, and the same change of connections makes the motor adapted for a higher speed by changing the ratio of series and repulsion motor action.

The only motor that has an inherent claim on unity power-factor is the direct-current motor. In every alternating-current motor a certain amount of wattless volt-amperes is consumed in magnetizing the field, and in leakage, so that the maximum torque is limited to a lower value than it is with the direct-current motors. An alternating-current motor with inherently good power-factor is one with high overload capacity, and this must be due to a comparatively small proportion of volt-amperes being consumed for magnetization. There are, however, artificial methods of bringing the power-factor of the alternating-current motor up to unity.

A series repulsion motor as developed for railway service has only one-third to one-quarter repulsion motor action, this being the proportion that gives sparkless commutation from synchronous to double synchronous speed. The lowering of the power-factor due to magnetizing current is therefore very slight, and with the greater liberty in design that is gained in the series repulsion motor, the power-factor is practically the same as in a series motor.

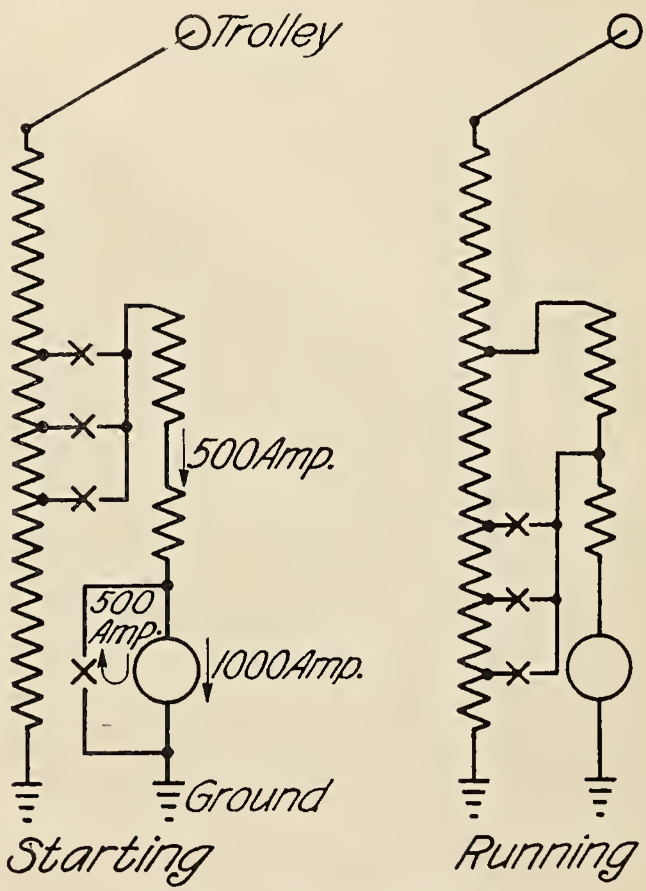
The analysis of the phase displacement also indicates how the power-factor can be corrected by shifting back the phase of the field current. This can be done in the series repulsion motor as well as in the series motor by shunting the field by a resistance according to the suggestion of Mr. A. S. McAllister. It can also be done, as has been experimentally demonstrated, by a slight degree of separate excitation of the field derived from the main transformer or from the stator coils. However, any raising or lowering of the power-factor of phase displacement does not affect the tractive effort or heating of the motor; it only changes the voltage that has to be applied in order to overcome the inductive drop. As soon as any artificial method of raising the power-factor involves any complication, for instance, another set of brushes on the commutator, it will probably prove preferable to improve the constants of the system by using synchronous machines wherever power is used for other purposes.

Resistance leads.—The use of resistance leads, which has been so much discussed, has been found to be unnecessary in motors of the type described. Certain motors which have been operated for a considerable time as series motors, and then rewound so as to embody the features described in this paper, have shown an increased life of brushes and commutator up to the standard of good direct-current practice. The improvement in commutation was so great that it was possible at the same time to increase the thickness of the brush and the output of the motor.

Selection of frequency.—In regard to choice of frequency, the series repulsion motor again gives greater liberty. Whereas the starting torque can be doubled on either 15 or 25 cycles, it may be mentioned that a series motor which was almost inoperative at a certain load at 25 cycles, after rewinding, as described, was tested as a series repulsion motor, and found to give excellent commutation at 40 cycles, at the same load. It can therefore be said in general that 25 cycles is entirely satisfactory for all geared motor work; it is preferable in that the combination of motor and transformer weighs less than at 15 cycles.

Economy of material.—The motor described can be built in larger capacities than the series motor. The principal reason for this is the inherently good commutation and increased starting torque which make resistance leads unnecessary, thereby eliminating the heat generated by the resistance leads, and also gaining space in the slots, which can be used for copper. Furthermore, it is possible to increase the flux per pole without impairing the commutation.

The fractional pitch winding which is used primarily for the sake of commutation is also advantageous from the point of view of economy of material. The saving extends not only to the end-connections, as is the case with the fractional-pitch induction motors, but also to the stator winding, inasmuch as only the active armature conductors, or only about 80 per cent of the total, need to be compensated for; whereas with the full-pitch armature, the entire winding must be compensated for. In neither case is it possible to utilize more than about 80 per cent of the total pitch as effective pole arc, because of the space occupied by the field winding. This principle is applicable to any type of compensated machine of the Deri type for alternating or direct current, except when the commutating pole is used. The fact that the number of poles in the series-repulsion motor can be selected without regard to the synchronous speed is an important consideration.



FIGS. 3 AND 4. THE SERIES-REPULSION MOTOR.

In summing up the preceding the particular advantage of the motor described may be claimed to be:

1. Good commutation at all speeds without the use of resistance leads.
2. Larger capacities possible than with the series motor.
3. High tractive effort possible, due to the liberty of selecting the number of poles.
4. Increased starting torque, possible because of the inherent ratio of winding turns, without supplying an increased current from the main transformer.
5. Simplicity of construction. The stator is the same as in the series motor, in fact easier to construct, due to the greater liberty of placing the field-winding in slots. The armature is constructed according to standard direct-current practice with the conductors soldered into the commutator bars.
6. Equally well applicable to direct and alternating current.

EFFECTS OF LIGHT UPON THE EYE.*

By Dr. H. H. Seabrook.

Illumination for near work is in a most unsatisfactory state. Our country leads the world, apparently, in the brilliancy of its artificial illumination, and certainly leads the world in ocular exhaustion, discomfort and congestion. When gas came into general use, these troubles began to increase, and a further increase was in evidence as the incandescent electric lamp came more and more into fashion. Both here and abroad, oculists agree that the kerosene burner is the least harmful artificial illuminant. They might leave the word artificial out with propriety, for no damage has been traced to kerosene light. The most satisfactory light is, no doubt, daylight (not sunlight), a few feet within a closed window, on a bright day. In this light, finer lights and shadows and delicate colors may best be distinguished by healthy eyes. A greater distance from the source of light diminishes vision, and even taking away the protection of the window glass causes more dazzling and decreased retinal endurance. The adaptability of the eye is small for increased illumination, and the limit of increase of vision with stronger light is within the medium limit of illumination. The light should come from the rear and left, and fall upon the object. If the latter has a glazed surface which reflects white light, fatigue is more rapid than with a dull surface, for below the surface of objects chemical rays are absorbed, and color and visibility is due to that portion of the white light which is not absorbed but returned to the eye from below the surface.

Analyses of light, as published, are difficult to comprehend by one who is ignorant upon the subject. Daylight, or sunlight, is a variable standard to take without further definition or explanation of the conditions. Meyer's analysis, as given by Cohen, has violet in the electric (arc) light as .3 to daylight 1, and as given by Staerkle, 1. An analysis published by the Acetylene Company gives for the violet in the arc light 1 to 1 for sunlight. Staerkle gives, for gas, violet, .1; Cohen, .3; the Acetylene Company, 1.15. Let us suppose that one table, giving the kerosene burner as very weak in violet rays, is correct, and another with ostensibly the same standard, omitting kerosene, is correct in giving the electric incandescent lamp what is meant to be the discredit of the weakness in violet rays as compared to the other illuminants; we must then look for contributory causes which have caused the incandescent lamp to give rise to more chronic eye degeneration and disturbance than any other light used for near work. Acetylene may be thrown out on account of lack of opportunity for much damage. The image of the brilliant filament of the incandescent lamp, with its concentration of light, must harm the retina more than the more diffuse images of flames; the benefit from ground glass globes for this light, when the eyes are exposed to its direct rays, must be partly due to diffusion of the light. Without ground glass, this light is more steadily brilliant than kerosene, gas, or the gas mantle burner, and there is less chance for retinal recuperation. Ground glass reduces all the rays of the light about twenty-five per cent. In searching for other causes of trouble, we note that the movable kerosene lamp may be, and is usually placed in a good position to illuminate the object, while the incandescent electric lamp is usually not well placed, often in offices being rigidly fixed so that either the eyes must be subject to direct light, or the head must be bent forward for work, congesting the eyes. No amount of green on a tin shade will correct this improper permanent position of the lamps. Again, we notice how very thin the glass bulb of the incandescent is compared with the lamp chimney, and since glass of five millimeters thickness absorbs twenty-nine per cent of the chemical rays of sunlight at an angle of sixty degrees (Hankel), we conclude we have another element of trouble, as chemical rays are absorbed by glass in proportion to its thickness.

The Welsbach mantle changes the ordinary gas flame, with its marked excess of red, to a cold light, deficient in that color. It is less irritating to some eyes than other lights, but more irritating to others.

Many substances absorb chemical rays and allow luminous rays to pass. For practical purposes, there seems no need to consider any of them except glass as a protection for the eyes from the intrinsic brightness of too intense light. Neither does there seem any question that yellow is the color to choose to conserve or improve vision and protect the eyes from the chemical action of light. Globes may be used of pink, orange, red, or green, as desired, when the light may be diminished in luminous qualities. It is best to choose for protective purposes that shade of yellow which appears in the best ray filters or is shown in the glass used for modifying the light of developing rooms for photographic plates. This amber yellow may be darkened by a brown admixture for weak or diseased eyes, or unusual light exposure. It is difficult to manufacture without imperfections, and the supply slowly follows the demand.

That the study of illumination for practical purposes is difficult, no one will deny. The difficulty of conveying knowledge about light, even if one possesses it, must be great, for there is no definite language, as of medicine, for instance. Newton first separated light into primary colors, and he also advocated the corpuscular theory of Descartes; and after more than two centuries we use Newton's language and speak of chemical rays in order to be understandable, and compound such sentences as "Since the wave lengths at the violet end of the spectrum are but half the length of those at the red, twice as many chemical rays as heat rays, from white light, enter the eye during the same period of time." When we speak of light in general, we usually mean light with infra-red, spectral and ultra-violet effects. Light rays may mean the visible spectrum, or the luminous yellow. The expression primary colors has just been used. It meant, then, the seven colors to be distinguished in the spectrum by many eyes, or the six that can be recognized by the others. It is frequently applied to the fundamental pigment colors, red, yellow and blue, from which all other pigment colors may be produced by mixing; or the fundamental spectral colors, red, green and violet.

Illuminating engineers are not entirely satisfied with standards of measurement of light; they would be still more confused if the visual standards which oculists have used for many years should be presented to them. Vision for distance only has been considered, and the apparent contradictions in facts, the long descriptions of investigations by Germans, often followed by conclusions entirely at variance with the premises, the conclusions of others, especially Americans, upon no premises at all, make "laws," as they were formerly called in these studies, rather difficult to formulate. In the present instance, you are asked to believe what many of you already know, that the desire for intensity of light has been already overdone as regards the good of the eyes. The small but increasing portion of the consumers who wish a light that is soft to the eyes, ought to be encouraged.

*Abstract from a paper read before the New York Section, Illuminating Engineering Society.

STANDARD MOONLIGHT SCHEDULES FOR 1908.

Compiled for mean local time, latitude 40°.

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out
1	5.15 P.M.		5.45 P.M.		6.20 P.M.		6.50 P.M.		7.20 P.M.		7.50 P.M.	
2	5.15 "	6.25 A.M.	5.45 "	6.10 A.M.	6.20 "	5.35 A.M.	6.55 "	4.45 A.M.	7.25 "	4.00 A.M.	7.50 "	3.35 A.M.
3	5.15 "	6.25 "	5.50 "	6.10 "	6.20 "	5.35 "	6.55 "	4.45 "	7.25 "	4.00 "	10.20 "	3.35 "
4	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	6.55 "	4.40 "	7.25 "	4.00 "	10.50 "	3.35 "
5	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	10.30 "	4.40 "	11.00 "	4.00 "	11.20 "	3.35 "
6	5.15 "	6.25 "	5.50 "	6.10 "	6.25 "	5.30 "	11.25 "	4.40 "	11.40 "	3.55 "	11.50 "	3.35 "
7	5.15 "	6.25 "	10.45 "	6.05 "	10.40 "	5.30 "	——	4.35 "	——	3.55 "	——	3.35 "
8	9.40 "	6.25 "	11.50 "	6.05 "	11.40 "	5.25 "	12.15 A.M.	——	12.20 A.M.	——	12.15 A.M.	——
9	10.50 "	6.25 "	—— "	6.05 "	——	5.25 "	1.00 "	4.35 A.M.	12.50 "	3.55 A.M.	12.40 "	3.35 A.M.
10	11.50 "	6.25 "	12.50 A.M.	——	12.40 A.M.	——	1.45 "	4.35 "	1.20 "	3.55 "	1.05 "	3.35 "
11	——	6.25 "	1.50 "	6.05 A.M.	1.30 "	5.20 A.M.	2.20 "	4.35 "	1.50 "	3.55 "	2.30 "	3.35 "
12	12.55 A.M.	——	2.45 "	6.00 "	2.20 "	5.20 "	2.50 "	4.30 "	2.15 "	3.50 "	No light.	3.35 "
13	1.55 "	6.25 A.M.	3.45 "	6.00 "	3.00 "	5.20 "	No light.	4.30 "	2.40 "	3.50 "	No light.	No light.
14	2.55 "	6.20 "	4.25 "	6.00 "	3.45 "	5.15 "	No light.	No light.	No light.	3.50 "	No light.	No light.
15	3.55 "	6.20 "	No light.	5.55 "	No light.	5.15 "	No light.	No light.	No light.	No light.	7.55 P.M.	No light.
16	4.50 "	6.20 "	No light.	No light.	No light.	No light.	No light.	No light.	No light.	No light.	7.55 "	9.50 P.M.
17	No light.	6.20 "	No light.	No light.	No light.	No light.	7.10 P.M.	No light.	7.35 P.M.	No light.	8.00 "	10.50 "
18	No light.	No light.	6.05 P.M.	No light.	No light.	No light.	7.10 "	8.50 P.M.	7.40 "	10.00 P.M.	8.00 "	11.40 "
19	No light.	No light.	6.05 "	7.55 P.M.	6.40 P.M.	No light.	7.10 "	10.00 "	7.40 "	11.00 "	8.00 "	12.20 "
20	5.30 P.M.	No light.	6.10 "	8.55 "	6.40 "	8.50 P.M.	7.10 "	11.00 "	7.40 "	12.00 M.	8.00 "	1.00 "
21	5.30 "	8.05 P.M.	6.10 "	9.55 "	6.40 "	9.50 "	7.10 "	12.10 A.M.	7.40 "	1.00 A.M.	8.00 "	1.30 "
22	5.35 "	9.05 "	6.10 "	10.55 "	6.40 "	11.00 "	7.15 "	1.15 "	7.40 "	1.40 "	8.00 "	2.00 "
23	5.35 "	10.00 "	6.15 "	12.00 M.	6.45 "	12.00 M.	7.15 "	2.20 "	7.45 "	2.20 "	8.00 "	2.25 "
24	5.35 "	11.00 "	6.15 "	1.00 A.M.	6.45 "	1.10 A.M.	7.15 "	3.00 "	7.45 "	2.50 "	8.00 "	2.55 "
25	5.35 "	12.00 M.	6.15 "	2.10 "	6.45 "	2.15 "	7.15 "	3.40 "	7.45 "	3.20 "	8.00 "	3.25 "
26	5.40 "	1.00 A.M.	6.15 "	3.15 "	6.45 "	3.15 "	7.15 "	4.10 "	7.45 "	3.40 "	8.00 "	3.30 "
27	5.40 "	2.10 "	6.15 "	4.25 "	6.50 "	4.10 "	7.20 "	4.10 "	7.45 "	3.40 "	8.00 "	3.35 "
28	5.40 "	3.15 "	6.15 "	5.25 "	6.50 "	4.55 "	7.20 "	4.10 "	7.45 "	3.40 "	8.00 "	3.35 "
29	5.40 "	4.25 "	6.20 "	5.35 "	6.50 "	4.50 "	7.20 "	4.05 "	7.45 "	3.35 "	8.00 "	3.35 "
30	5.45 "	5.35 "		5.35 "	6.50 "	4.50 "	7.20 "	4.05 "	7.50 "	3.35 "	8.00 "	3.35 "
31	5.45 "	6.15 "			6.50 "	4.50 "		4.05 "	7.50 "	3.35 "		3.35 "
1		6.10 "				4.45 "				3.35 "		

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out	Light	Out
1	8.00 P.M.		7.45 P.M.		8.35 P.M.		8.30 P.M.		10.30 P.M.		11.55 P.M.	
2	8.00 "	3.35 A.M.	9.10 "	3.55 A.M.	9.10 "	4.25 A.M.	9.20 "	4.55 A.M.	11.40 "	5.25 A.M.	——	6.00 A.M.
3	9.50 "	3.35 "	9.40 "	3.55 "	9.50 "	4.25 "	10.20 "	4.55 "	——	5.30 "	1.05 A.M.	——
4	10.20 "	3.35 "	10.05 "	4.00 "	10.35 "	4.25 "	11.30 "	4.55 "	12.55 A.M.	——	2.15 "	6.00 A.M.
5	10.40 "	3.35 "	10.35 "	4.00 "	11.30 "	4.30 "	——	5.00 "	2.10 "	5.30 "	3.25 "	6.05 "
6	11.10 "	3.35 "	11.10 "	4.00 "	——	4.30 "	12.45 A.M.	——	3.20 "	5.30 "	4.35 "	6.05 "
7	11.35 "	3.35 "	11.55 "	4.00 "	12.40 A.M.	——	2.00 "	5.00 A.M.	No light.	5.30 "	No light.	6.05 "
8	——	3.35 "	——	4.00 "	1.50 "	4.30 A.M.	3.15 "	5.00 "	No light.	No light.	No light.	No light.
9	12.05 A.M.	——	12.50 A.M.	——	3.05 "	4.30 "	No light.	5.00 "	No light.	No light.	No light.	No light.
10	12.40 "	3.35 A.M.	1.50 "	4.00 A.M.	No light.	4.35 "	No light.	No light.	5.20 P.M.	No light.	5.05 P.M.	No light.
11	1.20 "	3.40 "	No light.	4.00 "	No light.	No light.	6.00 P.M.	No light.	5.20 "	7.40 P.M.	5.05 "	8.05 P.M.
12	2.10 "	3.40 "	No light.	No light.	6.45 P.M.	No light.	6.00 "	7.50 P.M.	5.20 "	8.30 "	5.05 "	9.00 "
13	No light.	3.40 "	7.30 P.M.	No light.	6.45 "	8.55 P.M.	5.55 "	8.30 "	5.20 "	9.20 "	5.05 "	10.00 "
14	No light.	No light.	7.30 "	9.20 P.M.	6.45 "	9.25 "	5.55 "	9.10 "	5.15 "	10.20 "	5.05 "	11.00 "
15	8.00 P.M.	No light.	7.30 "	9.55 "	6.40 "	10.00 "	5.55 "	9.50 "	5.15 "	11.20 "	5.05 "	12.00 M.
16	8.00 "	10.20 P.M.	7.30 "	10.30 "	6.40 "	10.35 "	5.50 "	10.40 "	5.15 "	12.15 A.M.	5.05 "	1.00 A.M.
17	8.00 "	10.55 "	7.25 "	10.55 "	6.40 "	11.15 "	5.50 "	11.35 "	5.15 "	1.15 "	5.05 "	2.00 "
18	8.00 "	11.30 "	7.25 "	11.30 "	6.35 "	12.00 M.	5.50 "	12.30 A.M.	5.15 "	2.15 "	5.05 "	3.00 "
19	7.55 "	12.00 M.	7.25 "	12.00 M.	6.35 "	12.50 A.M.	5.45 "	1.30 "	5.15 "	3.15 "	5.05 "	4.00 "
20	7.55 "	12.25 A.M.	7.20 "	12.40 A.M.	6.35 "	1.45 "	5.45 "	2.30 "	5.15 "	4.15 "	5.05 "	5.00 "
21	7.55 "	12.55 "	7.20 "	1.20 "	6.30 "	2.40 "	5.45 "	3.30 "	5.10 "	5.15 "	5.05 "	6.10 "
22	7.55 "	1.25 "	7.20 "	2.05 "	6.30 "	3.40 "	5.45 "	4.25 "	5.10 "	5.20 "	5.05 "	6.15 "
23	7.55 "	2.00 "	7.20 "	2.55 "	6.30 "	4.40 "	5.40 "	5.15 "	5.10 "	5.50 "	5.05 "	6.15 "
24	7.55 "	2.40 "	7.15 "	3.50 "	6.25 "	4.45 "	5.40 "	5.15 "	5.10 "	5.50 "	5.05 "	6.15 "
25	7.55 "	3.20 "	7.15 "	4.20 "	6.25 "	4.45 "	5.40 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
26	7.50 "	3.50 "	7.15 "	4.20 "	6.25 "	4.50 "	5.35 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
27	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	5.10 "	5.50 "	5.10 "	6.20 "
28	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	8.20 "	5.50 "	9.45 "	6.20 "
29	7.50 "	3.50 "	7.10 "	4.20 "	6.20 "	4.50 "	5.35 "	5.20 "	9.30 "	6.00 "	10.55 "	6.20 "
30	7.50 "	3.55 "	7.10 "	4.20 "	7.45 "	4.50 "	8.15 "	5.25 "	10.45 "	6.00 "	——	6.20 "
31	7.45 "	3.55 "	8.05 "	4.25 "		4.55 "	9.20 "	5.25 "		6.00 "	12.05 A.M.	——
1		3.55 "		4.25 "				5.25 "				6.20 A.M.

For lighting time, read opposite date desired, under column Light. For extinguishing time, read opposite date of next morning under column Out. Make usual addition or subtraction for standard time. Time change for other latitudes in United States not important, though computation may be readily made.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

Vol. XX FEBRUARY 8, 1908 No. 6

EDITORIAL.

As a people, we are impatient of post-mortems. The reviving of the skeletons left by the San Francisco earthquake and great fire is not a popular procedure to the present San Franciscan, who has buried the past under the progressive present and promising future of the new city. In this issue, we show a few views of the damage wrought, simply as a comparison to be subsequently made by the many pictures of what has been accomplished in the rehabilitation of the city's street railway systems. There cannot be an effect without a cause, and there cannot be improvement without a need for it. We are now illustrating this need in order to emphasize the rapid progress made in its fulfillment. The story to come will be largely a technical description of track laying and building construction, enlivened by the indomitable spirit of a plucky people united for the common good of their commonwealth.

ILLUMINATING ENGINEERING.

The appearance of a new periodical for the illuminating engineer in England, long noted for its conservatism, emphasizes the rapid progress being made by this new science of light. Or should we not say art? For art is applied intelligence, while science is but systematized knowledge. True, science relates to something to be known, and there surely is much yet to be known about correct artificial lighting, not only in its more efficient production, but also in its less wasteful use. We know of no other gradual evolution of knowledge that more closely follows the steps of scientific progress delineated by Herbert Spencer, from the time of the cave dweller, with his bright, blazing pitch-pine torch, down to the present, with its brilliant incandescence, dispelling the darkness of ignorance and fear.

What we know of illumination has been taught us by the science of optics, of chemistry, of physics, and of electricity, that have continually supplied the art of artificial lighting with better materials and more perfect instruments. These are so closely interdependent that it is difficult to separate the primary. But, insomuch as light depends on the eye for its perception, and is capable of reflection, refraction, dispersion and interference, and as these phenomena have been classified by the science of optics, this is fundamentally the most important. Chemistry has likewise been indispensable, what with its analysis of oil and of coal and water-gas, its synthesis of calcium carbide for the commercial acetylene flame, its discoveries of the properties of the rare earths, as applied to incandescent mantles, and its metallurgical refinements in the production of the new metallic filaments. Physics, in its measurement of light intensity, is likewise closely intercorrellated with these two, while electricity's role is so well recognized as to require no comment. The demands of this art have urged science on to ever higher developments in striving for perfection.

The appropriateness of this appellation as demonstrated in its industrial or mechanical sense is likewise evident in its esthetic meaning, as embodied in the artistic lighting fixtures now designed. Thus does this term imply a duality of utility and of beauty.

If there is art, there must be artisans and artists to apply it. Yet the wide field of knowledge requisite for proper directive application raises its intelligent utilization above the manual training of a mere trade almost to the level of a profession. For this aristocracy of learning, whose prerogatives for ages were assumed by priest, lawyer and doctor, has recently been successfully invaded by the engineer. This is recognized by the Standard dictionary in its definition of a profession as "an occupation that properly involves a liberal education or its equivalent, and mental rather than manual labor, hence any calling involving special mental and other attainments or special discipline, as editing, engineering, acting, authorship, etc."

The doctor as the oculist has long known the danger that threatens our eyes in poorly lighted homes, schools and work places. The physiologist has shown us the structure of the eye and the effect on it of various light intensities and colors. But, as usual, it has been left to the engineer to solve the problem. Properly, too, for is not the engineer concerned with the conversion of energy into power, and is not light a manifestation of radiant energy measured by candlepower?

Nevertheless the principles of scientific illumination are simple and easily understood. The societies recently formed in this country and abroad are disseminating this knowledge among their members, and it will be but a short time before all lighting installations will be under the direction of a competent authority. The skilled workmen now engaged in this business require only the instruction of the architect or engineer to insure satisfactory lighting.

RESOLUTIONS ON FOREST PRESERVATION.

Adopted by the Board of Directors of the A. I. E. E., January 10, 1908.

Whereas, The American Institute of Electrical Engineers recognizes that water powers are of great and rapidly increasing importance to the community at large, and particularly to the engineering interests of the country; and,

Whereas, The value of water powers is determined in great measure by regularity of flow of streams, which regularity is seriously impaired by the removal of forest cover at the headwaters with the resulting diminution in the natural storage capacity of the watersheds, this impairment frequently being permanent because of the impossibility of re-forestation, owing to the destruction of essential elements of the soil by fire and its loss by erosion; therefore

Be it Resolved, That it is the opinion of the American Institute of Electrical Engineers that the attention of the National and State Governments should be called to the importance of taking such immediate action as may be necessary to protect the headwaters of important streams from deforestation, and to secure through the introduction of scientific forestry and the elimination of forest fires the perpetuation of a timber supply; and further

Be it Resolved, That the Committee of Forest Preservation be instructed to communicate these resolutions to all members of Congress, and to the Governors of all the States.

BOOKS RECEIVED.

A "Standard Handbook for Electrical Engineers" lives up to the full measure of excellence implied in its name. It covers the entire field of electrical engineering, from a complete presentation of the various units, properties and measurements of electrical circuits, through a discussion of magnets, transformers, generators, motors and batteries to the central station. After tracing the methods of transmission and distribution of the current, the collaborators have shown the details of its application to illumination, traction, chemistry, telephony, telegraphy, and miscellaneous uses. Sections on wiring and standardization rules, together with tables and statistics, conclude the book. The high professional standing of each of the specialists who have written each of the twenty sections, precludes any criticism of the material they have presented, and it is only in a few of the minor details that the carping critic can find fault. Naturally, much that appears here has been printed many times elsewhere, excepting those sections devoted to electric traction and electro-chemistry, which contain considerable new material. But the convenience of having the opinion of the leaders as to what is most important in each of their individual fields condensed into one handy volume, greatly offsets this. The numerous diagrams and curves are clearer and more concise in illustrating the information to be conveyed than would be photographs or involved verbiage. The great deficiency of a proper index, usually found in engineering books, has here been corrected in the fifty-four pages of alphabetical and topical reference, giving ready access to the subject sought. The material is nearly as much down-to-date as is that in the technical press. Last, and not least, important is the excellent binding of the thin pages that make up this condensed book. The forty-eight pages that are used to separate the various sections throughout the volume should be omitted, to reduce its size slightly. But, with so much to praise and so little to condemn, it will soon be found indispensable by all progressive electrical engineers. Its price is $4.00, and is published by the McGraw Publishing Company, of New York City.

PERSONAL.

P. J. Aaron, Seattle manager of the Western Electric Co., was in San Francisco during the past week.

Richard Spencer, manager of the California Electrical Company, of Los Angeles, has been in San Francisco during the past few days.

Clem A. Copeland, of Los Angeles, is in San Francisco on a short business trip, with the view of expanding his business in this direction. He and his father built the first electric light power plant in Southern California.

Mr. William W. Power has been appointed manager of the electrical department of the Boston branch of the H. W. Johns-Manville Company. He was formerly district manager of the Allis-Chalmers Company's Philadelphia office, and previous to that he was connected with the Christensen Engineering Company, as special representative throughout New England States. When that company was reorganized and made the National Electric Company, Mr. Power continued with the latter concern until he became associated with the Allis-Chalmers Company.

Mr. R. H. Mansfield, Jr., Secretary of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wisconsin, has been in San Francisco for the past week in the interest of his company. The Cutler-Hammer Company intends to either establish an office in San Francisco and carry a full line of their apparatus, or perfect arrangements with one of our manufacturers' agents to handle their line and carry a stock. Mr. Mansfield is making many friends for his house by his genial and pleasant manner. In a short interview with a "Journal" man, we were pleased to note his expressions of surprise at the great progress that has been made in the rebuilding of San Francisco. He expressed the belief that this field deserved the most careful attention from the Eastern manufacturers. Mr. Mansfield is visiting the Northwest, and will again visit San Francisco on his way home via Los Angeles. The "Journal" congratulates the concern that secures this agency, as the Cutler-Hammer Manufacturing Company manufacture a line of controllers that are sold to every manufacturer of dynamos in the United States.

TRADE CATALOGUES.

"Lifting Magnets and Recent Improvements in Them," is the title of a little booklet just issued by the Cutler-Hammer Clutch Co., of Milwaukee, makers of lifting magnets and magnetic clutches. The subject-matter of this booklet originally appeared in "Cassier's Magazine," for October, 1907, which is now out of print. This little booklet, which is printed in the form of a miniature magazine, traces briefly the development of the lifting magnet, illustrates the different kinds of magnets used for handling pig iron, metal plates and other classes of material, and explains, by an easily-understood analogy, how the magnetic "lines of force" support weights ranging from one to ten tons.

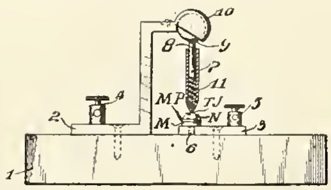
TRADE NOTE.

The Northern Electrical Mfg. Company, Madison, Wisconsin, announces the removal of its St. Paul office from 21 East Fifth Street to 516 Endicott Building, St. Paul. Mr. T. E. Drohan is in charge of the new office.

PATENTS

MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES. 877,451. Greenleaf W. Pickard, Amesbury, Mass.

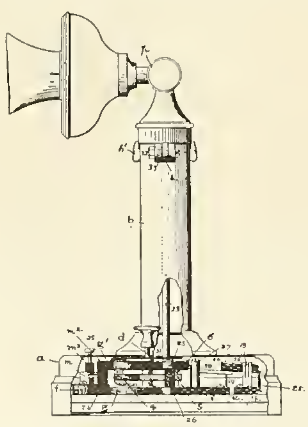
Means for receiving intelligence communicated by electro-magnetic waves, which comprises two substantially massive individual electrical conductors of different degrees of resistivity, and co-operatively having high resistivity, at least one of which conductors possesses high



resistivity; in combination with a spring which operatively holds the said conductors in substantially perfect small-areaed electrical contact with each other; and a freely movable, non-threaded support for said spring to permit a variation of contact pressure within wide limits of substantially perfect contact pressure, and thereby slightly vary the area of the minute electrical contact.

SWITCHING MECHANISM FOR TELEPHONE-CIRCUITS. 877,033. Albert K. Andriano, San Francisco, Cal., assignor to Direct-Line General Telephone Company, San Francisco, Cal.

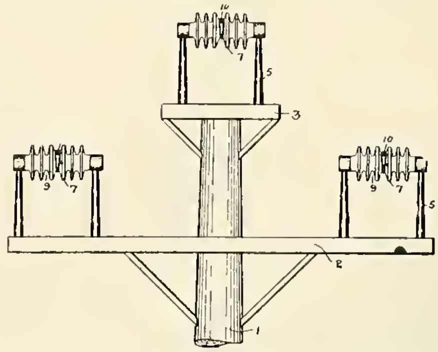
In a telephone switching-mechanism, the combination of two circular series of stationary-contacts in parallel planes one over the other, the contacts composing one series constituting separate terminals for individual lines, and a continuous contact-ring common to said contacts, insulated therefrom, the contacts in the other series comprising an inner plate having concentric and alternate salient and re-entering portions, and a surrounding ring



having corresponding but relatively larger salient and re-entering portions on the inner edge parallel with the corresponding portions on the inner ring, and separated therefrom; a rotatable switch-piece pivotally mounted between said upper series and lower series of contacts, and adapted to move in either direction, and contact-pieces on said movable switch-piece for making and breaking connection between the contacts in one series in alternate order to those in the other series by the same movement of the switch-piece.

INSULATOR. 876,939. Harold W. Buck, Niagara Falls, N. Y.

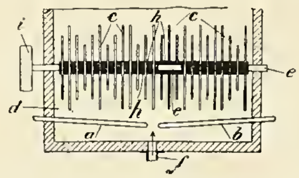
An insulator for electric conductors, comprising a cyl-



indrical body encircled by a series of corrugations and having a socket or recess formed in each end, and supports for body entering sockets or recesses and extending radially from body.

APPARATUS FOR MANUFACTURING NITRIC ACID OR OXID FROM AIR. 877,446. Harry Pauling, Gelsenkirchen, Germany.

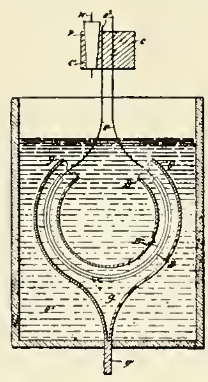
In an apparatus for manufacturing nitric acid or oxid from air, in combination, electrodes, arranged in a plane, for producing electric discharges, a number of plates so



disposed at one side of such electrodes as to cut the plane of the latter at right angles and form inter-spaces lying crosswise of the electrodes, means arranged at the opposite side thereof for blowing a current of gas through the space between the electrodes, and means for insulating the plates from each other.

MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS. 877,408. Francis M. F. Cazin, Hoboken, N. J.

A filament or luminant for electric incandescent lamps, composed primarily of a carbon-core, a thereon electrolytically plated coat of metals, of which the surface concentrical layer is oxidized on its surface—the several ma-



terials being so proportioned that after the luminant has been subjected to heat, it will consist of a central fillet of carbon, a concentrical layer of a mixture of carbon and metal, an adjoining layer of metal of the ruthenium-osmium-group—a layer of rare-metal oxidized on its surface.

INDUSTRIAL

MUELLER SCHOOL.

The traveling salesmen of the H. Mueller Mfg. Co., on January 11th, concluded their annual school of instruction which lasted two weeks, in the home office in Decatur, Ill.

Among other things to engage their attention, was the new nine-hundred-page catalogue, D, of water, gas and plumbing goods, now being sent out to the trade. The work on this very complete book was finished a few days before Christmas, and its delivery to the salesmen, who had anxiously anticipated it for a year, was greeted with cheers and applause.

Hennessy, Hastings and Fletcher sang as a solo and a trio, "I Got Mine." Much of the success of the initiation was due to Mr. Mon. T. Whitney, the president of the "49 Club," whose keen sense of humor and excellent powers of mimicry made him an ideal officer.

Following the revel of the club, the members, with a few invited guests, went to Strouse's Cafe, where a tempting banquet was served and toasts responded to. Mr. Adolph Mueller presided as toastmaster.

The "49 Club" elected Mr. F. J. Murphy as their president, to succeed Mr. M. T. Whitney. Cuts of these two gentlemen, who are well known to the trade, are shown herewith.

During the school of instruction, the catalogue was carefully reviewed and the goods discussed to bring out the best points. These schools of instruction have been prolific of good to the salesmen in the past, but the one just closed was voted by all as the most profitable. . The sessions of the school were held daily from 9 to 12 and from 1:30 to 3:30, the president of the company presiding and all members of the company being present.

The salesmen found relaxation in their annual session of the "49 Club," held Tuesday evening, January 7th. There were three candidates for initiation—W. F. Hennessy, R. M. Hastings and E. D. Fletcher. Printed words are inadequate and impotent to convey an intelligent understanding of what really happened to the candidates during an uproarious hour and a half. When it was all over,

The following is a list of the salesmen of the Mueller Company, and the territory they cover:

Decatur Territory.

W. N. Dill, Pacific Coast, Idaho, Utah and Nevada.

Murray F. Kirkwood, part of Kansas, Nebraska, Colorado, part of Wyoming, and Western Iowa.

Frank J. Murphy, Southern Texas, New Mexico, Arizona, Old Mexico and Panama.

Scott E. Hamblin, Oklahoma, Indian Territory, Northern Texas, Southeastern Kansas.

W. B. Ford, Southern States, east of the Mississippi, and east point of Arkansas.

J. Arch Colbrun, Missouri, Southern Illinois, Arkansas, Southern Iowa, west point of Kentucky.

David E. Rowley, Southern Indiana, Eastern Illinois and Western Kentucky.

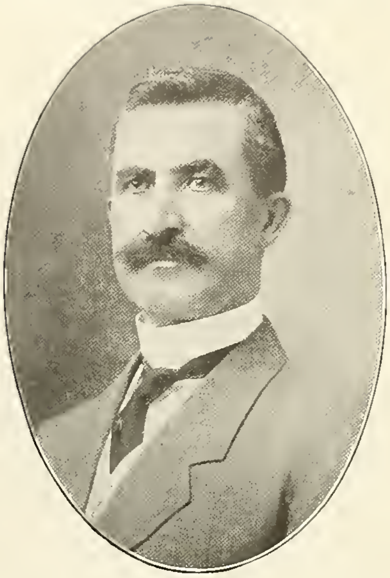
J. H. McCormick, Ohio and Eastern Kentucky.

James Smith, west of Pittsburg, West Maryland and West Virginia.

W. C. Heinrichs, Minnesota, North and South Dakota, Montana, Northern Wisconsin, Northern Wyoming, west of Upper Michigan, Manitoba and Northwest Territory.

Mon. T. Whitney, Northern Illinois, Southern Wisconsin and Northeastern Iowa.

H. F. Clark, Southern Michigan, Northwest corner of Ohio, Northern Indiana, Eastern part of Upper Michigan.



F. J. MURPHY, PRESIDENT "49-CLUB."

New York Territory.

R. M. Hastings, Northern Pennsylvania, Western New York.

E. D. Fletcher, Northern New Jersey.

W. F. Hennessy, New York City, Manhattan and The Bronx.

Geo. A. Caldwell, Maine, Rhode Island and Eastern Massachusetts and Eastern New Hampshire.

Al. F. Kice, Long Island and Brooklyn..

Arthur C. Pilcher, Western Massachusetts, Connecticut, Vermont, Western New Hampshire, and Northeastern portion of New York State.

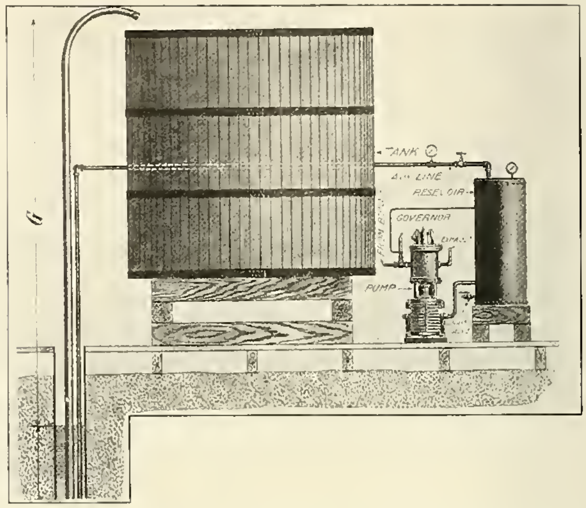
C. T. Ford, Delaware, Eastern Maryland, Virginia and a portion of North Carolina.

W. F. McCarthy, Southeastern Pennsylvania.

WESTINGHOUSE AIR COMPRESSORS FOR PUMPING AND CONVEYING LIQUIDS.

The advantages of employing compressed air for pumping water, oil and other liquids from wells, vats and tanks, are so pronounced that within the last few years this system has come into general use in a great variety of industries. Its simplicity and ease of maintenance make it far superior to any other means of conveying liquids. In deep wells particularly, great economy is found in the use of air as compared with the old-time deep-well pump. No valves, no reciprocating rods and plungers, and no wasteful steam cylinders at the well to operate them, are needed. The air system requires nothing but pipes properly proportioned as to size, length and connections, which, when once placed in position, remain indefinitely without need of attention or repairs. The air may be compressed in an existing power house, or at any convenient point, regardless of the distance from the well. Several separate wells, if desirable, can be pumped from one central station.

Westinghouse compressors, both steam and motor driven, have been found so well adapted to this class of service, that they are now extensively employed for compressing air to raise or convey liquids in breweries, tanneries, oil wells, dairies, hospitals, chemical laboratories, and acid plants, in addition to all kinds of water wells. Though the problem of pumping by compressed air with given con-



ditions is a simple one, conditions differ so widely that it is impossible to arrive at a satisfactory solution by mathematical analysis. Results of actual tests are necessary to form a correct basis of figuring. Realizing this, and desirous of assisting their patrons in every possible way to obtain the best results, the Westinghouse Air Brake Company has lately completed a series of nearly 2,000 tests covering a range of from 350 to 400 different conditions of deep-well pumping, to obtain data concerning water delivered, air consumed and the best proportion and arrangement of piping and apparatus.

Heretofore tests have been made on wells having fixed conditions, and the results, covering a number of isolated cases, have been the only guide in considering the requirements for all other installations. In this case, however, the tests were made with a well driven on the premises of the Westinghouse Air Brake Company, specially fitted up for experimental work.

So far as is known, no such wide range of tests has ever before been made upon a single well. The results place the manufacturers in a position to be of great assistance to those desiring to install compressors for direct air pressure pumping.

The accompanying illustration shows the simple arrangement of piping used when the inside diameter of the well casing permits a discharge pipe and an air pipe, both of suitable size, to be placed side by side in the casing. Much additional information is given in a booklet (No. 9,006) published by the Westinghouse Air Brake Company, devoted entirely to the subject of pumping liquids by compressed air.

NEWS NOTES

FINANCIAL.

San Diego, Cal.—The stockholders have authorized an increase of the capital stock of the San Diego Electric Railway Company to the sum of $5,000,000.

Los Angeles, Cal.—The City Council has provided for issuing $510,000 of Owens River bonds. This is the second issue, and will be used to pay a large force of laborers.

Petaluma, Cal.—The Petaluma Power & Water Company, at its annual meeting, elected the following Directors: Henry Lawrence, Conrad Peohlmann, H. T. Fairbanks, M. Doyle and A. B. Hill. The president is A. B. Hill; vice-president, H. T. Fairbanks; secretary and superintendent, Fred Heseker.

Pasadena, Cal.—An ordinance has been passed by the City Council calling for a special election for February 20, for the purpose of voting bonds in the sum of $50,000 for municipal improvements. Among the improvements is the construction of lines of poles, wires and apparatus for the distribution of electric lights in the city.

San Francisco, Cal.—Patrick Calhoun, president of the United Railroads, who returned from the East recently, confirms the report that he has raised $5,000,000 to take up the company's floating debt, and to make many improvements. Among these is the construction of a power plant for the operation of the company's entire system, the reconstruction of tracks, and the general betterment of the service. About $2,000,000 of the $5,000,000 secured in New York has already been transmitted here. The company paid $325,000 in city and county taxes last week.

Los Angeles, Cal.—The District Attorney holds that the Los Angeles Railway Company must pay the $43,000 tax on its franchise. The railroad company, which maintains its headquarters in San Francisco, will now file suit to test the validity of the law by which a tax is imposed on its State franchise, and will press it to the highest court. If the corporation should lose, the point will be raised whether the City and County of San Francisco, where it has its principal offices, is not entitled to the franchise tax, rather than Los Angeles County, where it operates.

San Francisco, Cal.—By the terms of a deed of trust for $45,000,000, filed January 30, the Pacific Gas & Electric Company completes control of the gas and electric plants in twenty-five counties of California, including San Francisco, Alameda, Santa Clara, Sacramento, Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Marin, Napa, Nevada, Placer, Plumas, San Joaquin, San Mateo, Santa Cruz, Solano, Sonoma, Sutter, Tuolumne, Yolo and Yuba counties. The consolidation of all the gas and electric plants was effected by a transfer to the California Gas & Electric Corporation of all the property and franchises of the following companies: Oakland Gas, Light & Heat Company; Oakland Equitable Gas Company; Berkeley Electric Lighting Company; Bay Counties Power Company; Valley Counties Power Company; Yuba Electric Power Company; Nevada County Electric Power Company; Butte County Electric, Power & Light Company; Standard Electric Company, of California; Stockton Water Company; Blue Lakes Water Company; Sacramento Electric, Gas & Railway Company; Central Electric Railway Company; San Mateo Power Company; United Gas & Electric Company, and the shares of stock of the South Yuba Water Company. The California Gas & Electric Corporation has also filed a certificate of the increase of its capital stock from $15,000,000 to $50,000,000, besides the increase of bonded indebtedness from $10,000,000 to $45,000,000.

TELEPHONE AND TELEGRAPH.

Modesto, Cal.—J. D. Harp has asked and received permission from the Board of Supervisors, to erect and maintain a telephone line along the Crows Landing road.

Santa Rosa, Cal.—Plans for the new telephone building which is to be erected on Third Street by Alfred Trembley in the near future for the Pacific States Telephone Company have been submitted to the company. It will occupy forty feet on Third Street, running through the block, and be equipped with a new plant.

San Francisco, Cal.—The police and fire commissions have decided to suspend further manufacture of fire alarm boxes in the department shop. The majority of the commissioners believe it will be cheaper to purchase from time to time such boxes as may be needed, the proposition being to dispense with the services of about eight men by stopping the home manufacture.

San Francisco, Cal.—The new telephone service which has been installed by the Pacific States Telephone & Telegraph Company to connect Oakland, Alameda and Berkeley with San Francisco direct, was put into operation this week. The system was completed some days previous, but the management waited before opening the new lines to the public, to complete the distribution of a new telephone directory. This will combine the telephone numbers for San Francisco, Oakland, Alameda and Berkeley.

INCORPORATIONS.

Chico, Cal.—The Feather River Power Company has filed articles of incorporation here, the capital stock being $1,000,000, and the incorporators, A. E. Boynton, S. A. Moss and C. F. Meteer.

Ukiah, Cal.—The Clear Lake Telephone & Telegraph Company has filed articles of incorporation here, the capital stock being $50,000 and the incorporators H. S. Johnson, A. H. Spur, L. J. Shuman, M. S. Sayre and F. L. Wright.

Hanford, Cal.—The Corcoran Water & Gas Company has been incorporated with a capital stock of $50,000 by E. O. Hanson, A. H. Potter, R. V. Milner, L. S. Randolph, J. B. Mayer, Geo. Hanna and J. W. Guiberson.

Bakersfield, Cal.—The Fairbanks Oil Company, of Berkeley, has filed its articles here, with a capital stock of $25,000, J. C. Morrison, M. P. W. Albee, William J. Acheson, Francis Ferrier and H. W. Fairbanks being the directors.

Los Angeles, Cal.—Articles of incorporation have been filed by W. S. Collins, E. L. Geraldine, C. H. Collins, J. C. White and C. R. John, as directors for the Geraldine Tract Water Company. The company is capitalized at $30,000.

Hanford, Cal.—The proposed Granger electric railway enterprises in this county have been incorporated as the Hanford & Lemoore Inter-Urban Railway Company, by Mr. Granger and his associates. The capital stock is placed at $1,000,000.

Napa, Cal.—Articles of incorporation of the Vallejo Irrigation & Power Company have been filed here. The life of the corporation is for fifty years, and its principal place of business is Napa. The first board of directors are: Joseph A. Migliavacca, E. W. Doughty, W. G. Thompson, L. E. Johnson and Harry L. Johnson, all of this city. The company is capitalized at $500,000.

Reno, Nev.—The North Yuba Electric Light & Power Company has filed articles of incorporation here. The capital stock of the company is $1,000,000, and the incorporators are Samuel B. Crane, William B. Barstow and Earl Talbot. The company plans to build a power plant on the North Yuba River, and to supply electricity to various towns and localities in California and Nevada.

TRANSMISSION.

Oakland, Cal.—The Supervisors have granted a franchise to erect poles and string wires throughout the county, to E. M. Downer, of Pinole, for the conveyance of electricity to be used for any purpose except telephones and telegraphs. The California Railway was given a franchise to construct an electric railroad from Fulton Street, near Lloyd Avenue, to Washington Avenue, and thence to the right of way of the Southern Pacific Company.

Riverside, Cal.—A permit has been granted by the Board of Supervisors to the Corona Gas & Electric Company, to erect and maintain a pole and electric transmission line over certain roads and highways in Riverside County.

ILLUMINATION.

Banning, Cal.—A company capitalized at $25,000 has been organized here, to put in a gas plant. C. D. Hamilton is president, and Dr. J. C. King, secretary. The plant is to be started at once.

THE
Journal of Electricity, Power and Gas

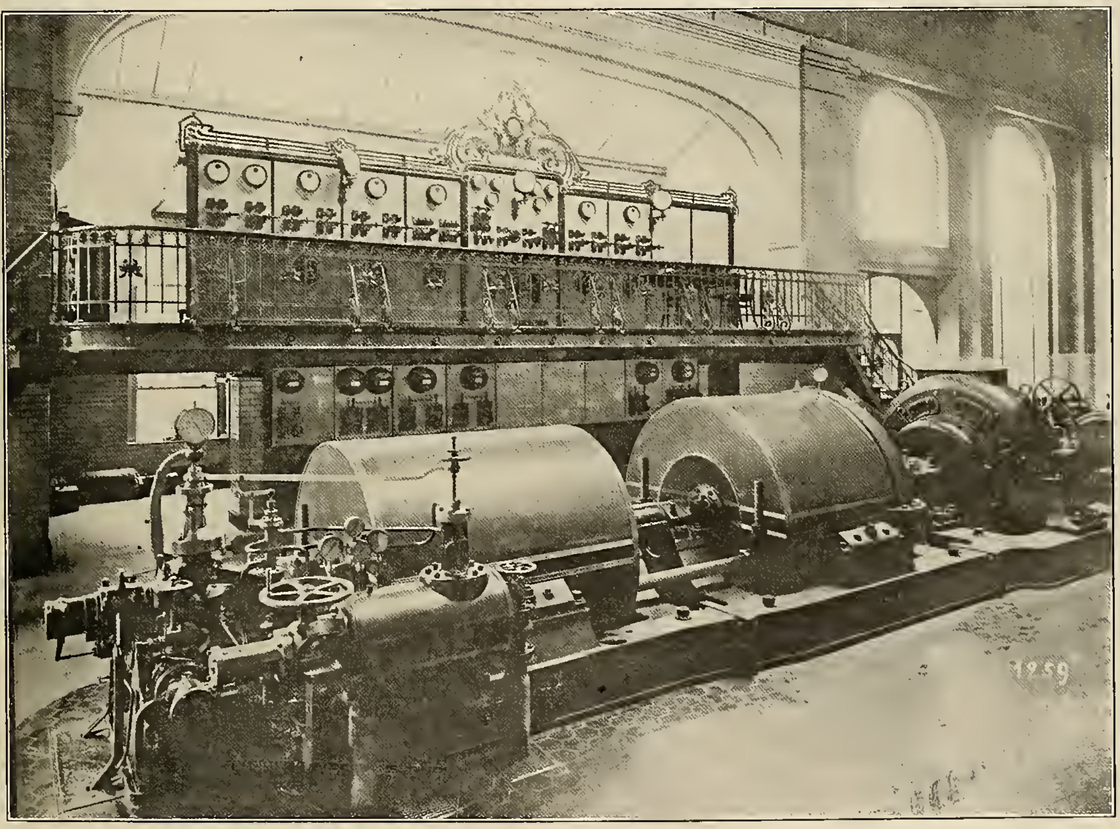
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., FEBRUARY 15, 1908 No. 7

THE STEAM TURBINE PLANT AT THE SIEMENS-SCHUCKERT-WERKE, BERLIN.

The accompanying illustration shows a 2,000-horsepower Zoelly turbo generator in the power house of the Siemens-Schuckert-Werke, at Nonendamm, Berlin. There are three of these units in operation at this power station, each driving by direct connection a pair of continuous-current dynamos of the Siemens-Schuckert type. Each turbine is provided with a surface condenser, located below the turbine and dynamo room, while the main switchboard of this plant is seen in the accompanying illustration.

two distinct parts, including a turbine wheel and a guide, the duty of the latter being to properly direct the steam into the former. The turbine wheel is designed to absorb the energy of the steam, transmitting it to the shaft and thus performing work. The modern steam turbine is usually made up of several states, each of which consists of a turbine wheel and guide, the steam passing successively through these various stages, and the pressure being gradually extended down to that of the condenser.



2000 H. P. TURBO-GENERATOR AT THE SIEMENS-SCHUCKERT-WERKE.

While the first steam turbine of the reaction wheel type dates back to the time of Hero of Alexandria more than a century before direct current, and the reciprocating steam engine is of comparatively recent design, the latter has held the field of steam power movers almost exclusively until the past decade or two of the last century.

The modern steam turbine has hardly been a real competitor until within the past two decades, when the two general classes of "simple action" and "reaction" turbines with pressure stages were developed, all of these turbines having

The Zoelly steam turbine is of the parallel flow "simple action" type with a minimum of nine or ten stages, which are said to reduce the wear to a minimum amount, these stages being placed in two casings or in one casing, according to the output of the turbine and other conditions. It is maintained that the high-speed of the steam, equivalent to twelve hundred feet per second or more required by the small number of one, two or three small stages, greatly shortens the life of such a turbine, causing great wear of the blades.

The reaction steam turbine has a distinguishing feature that the pressure is converted into speed in the turbine wheel partly, and also on the guide, there being therefore a difference in pressure between the two sides of the wheel, resulting in the thrust longitudinally and also a loss of steam amounting to considerable, due to the clearance between the stationary turbine parts and the wheel. Extreme care is therefore necessary in the construction of the reaction turbine, as the radial clearance must be reduced to a minimum, and the stripping of blades would be the result of careless construction, while a special balance piston is necessary, having very small play, as a simple thrust bearing cannot be depended upon to take care of the heavy axial thrust.

Those engineers favoring the action turbine over the reaction turbine maintain that the former has a great advantage in that the pressure is converted into speed in the guide exclusively and enters the turbine wheel with its full "vis viva," while the pressure is not lowered in passing through the turbine wheel and there is no leakage or axial thrust. It is said that a large radial clearance can therefore be allowed between the stationary parts and the turbine wheels, without affecting the efficiency of the machine turbine.

The two forms of action turbine may be designated as the "simple-action turbine," so designed that the steam jet acts only on one wheel, and the "action turbine with steam stages," constructed so that the speed of the jet is absorbed by several wheels successively, between each of which a guide is provided to properly direct the steam.

COPPER MARKET SITUATION.

The copper situation, from a market standpoint, shows some actual gain since our previous issue, and quotations for electrolytic wire bars are now on a 14@14¼ cent basis. European shipments keep up on an unusual scale, and nearly all the surplus has been distributed among foreign countries. The exports are expected to average high for some time longer. These recent heavy shipments have cut down supplies just that much, but there still appears to be enough copper for all purposes required by a limited local demand.

Europe was a heavy buyer of cheap copper during the last three months of 1907, but it is no secret that a large percentage of the 100,000 tons shipped abroad between October 1 and December 31 must come again on the market before it reaches the final consumer. Dealers and speculators are waiting for a chance to resell their holdings, and this important fact is one not to be lost sight of. If foreign trade requirements were equal to what the enormous exports from this country might seem to indicate on the surface, copper in all the markets of the world would quickly sell higher than it does. But we all know that Europe is not using copper at the rate imported. A great deal has gone into, and reshipments to the United States are among the possibilities at higher prices.

The experiences of the past should carry with them some valuable lessons, and a determination to do every thing possible to develop American consumption of copper to the entire productive capacity of the country is worthy of being prosecuted most energetically. In line with this purpose let the manufacturer be assured of getting copper at a reasonable price from January to December, and in quantities that will permit him to extend his plant each year at about the same ratio as production increases. On such conditions home consumption should develop enormously inside of five years, and in this way the mining companies also would promote a growing demand for their product in this country which would place additional millions in their treasuries.—"Copper Gossip."

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces examinations on April 15-16, 1908, to secure eligibles from which to make certification to fill vacancies as they may occur in the positions of junior engineer and assistant engineer in the Reclamation Service. Salaries: Assistant engineer, $1,500 per annum and upward; junior engineer, $720 per annum and upward. Age limits: Assistant engineer, 25 to 45 years; junior engineer, 20 to 45 years. Applicants for the position of assistant engineer must indicate in their applications that they have had at least four years' practical experience in engineering. A technical training in college will be counted as two years' experience. All questions in the junior engineer examination are such that any competent third or fourth year technical student with little practical experience may be expected to answer them satisfactorily.

An examination will be held on March 4, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of apprentice draftsman (male), office of the Chief of Ordnance, War Department, at $360 per annum, and vacancies requiring similar qualifications as they may occur in that Department. Promotion is made up to $60 per month, in the discretion of the Chief of Ordnance. An apprentice may enter the competitive examination for the position of draftsman (entrance salary, $1,000 to $1,200) whenever, in the opinion of his superior officer, his training and experience are sufficient.

On March 4, 1908, examinations will be held to secure eligibles from which to make certification to fill a vacancy in the position of aid, $600 per annum, in the Bureau of Standards, Department of Commerce and Labor, similar vacancies as they may occur in that Bureau, at $600 and $720 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service. The examination will consist of elementary algebra, geometry, and trigonometry, general physics, elementary mechanical drawing. Applicants must indicate in their applications that they are graduates of mechanical training, technical, or scientific schools, or have had equivalent training in scientific or technical laboratories. Qualified persons are urged to enter this examination. The work of the Bureau of Standards is scientific and technical in character, consisting principally of physics, chemistry, and mechanical and electrical engineering. It employs a large number of experts in each of these branches. Young men filling successfully the position of aid are eligible for promotion in the lines of work in which they have become efficient. The opportunity for study and advancement along the lines indicated is equal to that of the leading commercial or educational institutions. Age limit, 20 years or over on the date of the examination.

The United States Civil Service Commission announces an examination on March 4, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of supervising engineer, at $125 per month, under the War Department, and vacancies requiring similar qualifications as they may occur. The Department states that the service in the position mentioned will be required for a period of six months from January 1, 1908, in the Chickamauga and Chattanooga National Park. The examination will consist of theory and practice of location and construction of roads, and training and experience in road construction. Applicants must indicate in their applications that they have had at least one year's experience in road construction, and at least five years' experience in engineering. Graduation in civil engineering in any reputable school will be considered as equivalent to three years' experience. Applicants who have not had such experience will not be admitted to the examination.

REHABILITATION OF SAN FRANCISCO'S STREET RAILWAYS.

By Arthur H. Halloran.

(Continued.)

In less than two weeks after the fire, the demand for unskilled labor greatly exceeded the supply. Thousands of tons of the debris of destruction delayed the work of construction. Streets had to be cleared before lots could be cleaned. Men, horses and wagons were necessary. All available around the city were insufficient, so recruiting agents were sent throughout the country to bring them in. The street railway companies were already equipped for gang getting, but as soon as these men arrived, having been "found" for days and miles, they were gathered in by others paying higher wages. But, notwithstanding this, the United Railroads had six hundred men at work on the streets in May.

REMOVING PAVING BEFORE TAKING OUT CABLE TRACKS.

By their efforts, most of the existing electric lines were cleared and the overhead put in order. As quickly as this was accomplished, cars were run on most of the important lines, including Sixteenth and Fillmore, Devisadero, Mission and Market Streets, with several of their connections. Immediately after the fire Mayor Schmitz gave permission to string trolley wires along Market Street, so as to give transportation along this main thoroughfare. As the rails were welded and as the old cable conduits were good conductors, this line gave good service without bonding.

But these electric lines, eighteen in number, were insufficient to supply the needs of many residential districts of the city formerly served by cable roads. As already indicated, the cable power houses were in ruins and would take a long time to rebuild. The Sutter Street line had few heavy grades and was needed at once, so permission was obtained to electrify it and its extension on Market Street to the ferries; and also the Polk and Larkin Street cross-town lines, needed for the new shopping district on Van Ness Avenue. Hayes, Haight, McAllister, Valencia and Castro Streets, formerly Market Street cable extensions, were also converted in turn. Turk Street was relaid from Market to Larkin, and connected so that the cars would run to the ferries. Sacramento, from Fillmore to Devisadero Streets, and Jackson, from Fillmore to Presidio Avenue, gave service to the northern part by electric traction. Extensive work was also done on Mission, from Fifth to Twenty-Sixth Street, and from Virginia to Randall. The cable road along Fulton from Stanyan to Fifth Avenue, was changed to electric and continued west along the south side of the park. Fourth Street, between Townsend and Howard, was completely rebuilt, as was also Howard, between Seventeenth and Eighteenth Streets, Brannan between Fourth and Fifth, and Folsom between Fifth and Seventh, these latter all being in the fire zone.

BREAKING YOKES WITH JACK.

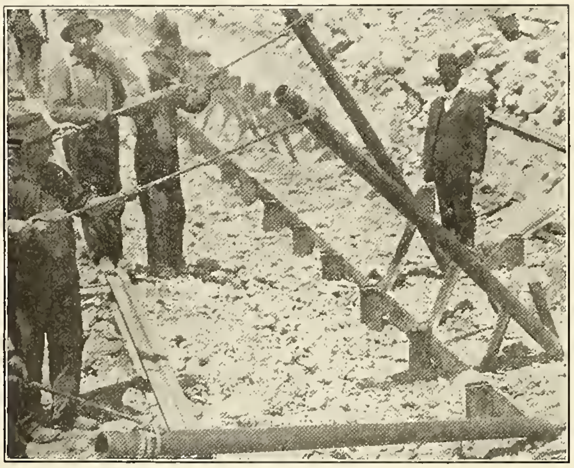
Each one of these often presented peculiar difficulties. Traffic was maintained over some of them almost continuously by working on one track at a time. On others, thousands of men were at work at once, blocking the street for blocks. But a complete account of each individual case would involve repetition and exceed the possible limits of this paper.

BREAKING OUT YOKES.

So our remarks must be confined to a general description of all work, specializing in a few of the more important details.

This work, with that done on a number of cross-town lines, has taken till now to complete. At first it was organized into departments of debris removing and engineering, the former being handled by the Debris Transportation Company. This company had been organized soon after the fire,

to assist in quickly clearing the wreck. The Southern Pacific. Santa Fe, Ocean Shore and United Railroads placed every facility at its disposal, and temporary tracks were laid on many of the down-town streets. Bunkers, bins and platforms were erected to receive the debris, which was loaded on to flat cars and hauled at night to Islais Creek and China Basin, which were filled in to make new land. John B. Rogers, chief engineer of the Ocean Shore Railway Company, superintended this work for a month. But when its operation was taken over by the United Railroads, Mr. B. Peyton Legare took charge. A small steam locomotive and an electric locomotive were used, as many of the curves were too sharp to be taken by the usual form of engine. Scrap iron was loaded into gonola cars and shipped to outside points, where it commanded a good price, but flat cars holding from twenty to thirty cubic yards were used for the brick, mortar, etc. A uniform charge of $5.00 per car was made to all contractors. While this method cleared the city rapidly, it did not prove a financial success to its backers. Tracks were ordered moved and removed so often that much valuable time was lost, and it was finally given up, in March, 1907.



PULLING OUT CABLE ROAD BED.

By this time the construction work became too heavy for the Engineering Department, and on October 1st, 1906, was organized a Construction Department, and a Department of Maintenance of Way, Mr. B. Peyton Legare taking charge of the latter. Subsequently, they were consolidated under his supervision. Mr. Legare kindly furnished all this information on track construction:

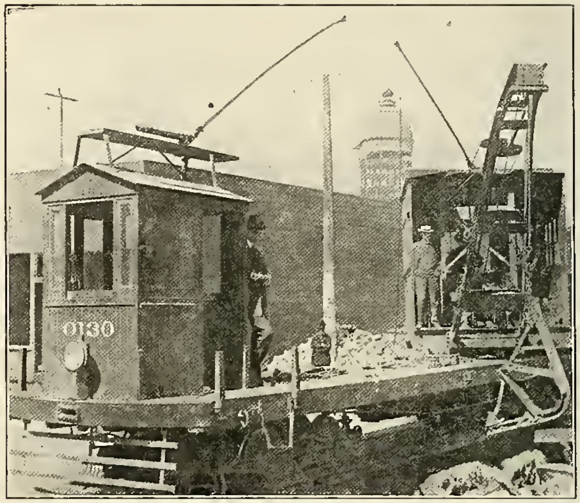
The department consisted of a chief engineer, a principal assistant, four assistants, superintendent of outside construction, and three general foremen. Each general foreman had charge of a certain division, and had ten or twelve foremen of gangs under him. These gangs consisted of from 75 to 200 men with straw bosses. These men made up one of the most cosmopolitan aggregations assembled on one job since the building of the Tower of Babel. Greeks were predominant, often closely twinned with Italians. Roumanians were frequently interspersed with occasional inclusions of Russians. Hungarians and Austrians worked in scattered groups. But the Irishman was the boss.

During the Fall and Winter of 1906 and the early Spring of 1907, this force varied from 4,000 t o5,300 men. At one period there were 75 time-keepers employed to satisfy them. At first they worked ten hours for $2.25 per day, but being infected with the fever of organization, they successively demanded and obtained reductions to nine and eight hours, with increase to $2.50 per day, getting a rebate for excess time while this was being decided by the Board of Arbitration.

Each man in this army was furnished with two car tickets a day, and half of them either walked to and from work or stole rides. Consequently a car ticket was included in the cigar purchase of those "wise." These were bought and sold in blocks of 1,000 for two and one-half cents apiece, having been distributed at the rate of four hundred dollars per day. This mis-use, or, more properly, abuse, finally caused the removal of the privilege.

Tool camps were established all along the street to be attacked, with from ten to twenty tool boxes containing bars, gads, hammers, picks, etc. These were sharpened at portable forges in the blacksmith shop accompanying each camp. A watchman day and night was not sufficient to prevent much of this material being stolen. Dismantled cars placed on side streets served as field headquarters for the division engineer and transit men, as well as the time-keepers.

The accompanying pictures have been selected from the collection of the United Railroads, as prepared by John H. Mentz, their official photographer. They illustrate the different steps in this track construction in all parts of the city,



CABLE YOKES BEING REMOVED WITH DERRICK AND CHAIN.

showing the work from the removal of the paving to the finished job, including the different methods of removing the cable yokes, crushing rock, rolling the ballast, placing the rails and filling and tamping.

The paving, whether basalt blocks or asphalt, was loosened with bars and gads, exposing the slot rail and old rails on either side. The bolts were cut from these with chisels, and they were removed, to allow excavations alongside the concrete cable conduits. The concrete was cut away enough with steel gads, so that a chain or a ring could be put around the yoke, preparatory to removal. This was done in a number of ways. On Sutter Street, where the old gauge was too wide to take the derrick cars, a lever was rigged up with a rail, and the yoke with attached concrete pulled out by hand. On Haight and some of the other streets, an electrically-operated derrick jerked them out and dropped them to one side. In places the tops of the yokes and arms were merely cut off with chisels, far enough down to be eight inches below the tie level. One of the pictures shows jacks being used to pull them out. The best method was the use of heavy iron rings made of 1x2-inch stuff attached to a lever. These were slipped around a section which was then jerked out by the derrick.

A rock crusher, electrically driven and mounted on a car, broke up the concrete for use as ballast. The concrete usually came out in huge chunks enveloping the cable yokes. These were allowed to drop onto the street, to break up the mass. The yokes were cast to one side, and the broken rock fed

through the crusher. Thus ballast was obtained where needed, without hauling. Some of it was broken by hand, and some obtained from outside sources. After eight inches of ballast had been put in, it was thoroughly rolled with a 10-ton steam roller. Hewn redwood ties 6x8 inches by 8 feet long were put in position and rails spiked on. The standard are 60-foot lengths of 9-inch, 109-pound, grooved or trilby girder rails, tied with 7/8-inch steel tie-rods every ten feet. Heavy work, as on Market Street, was braced every eight feet by steel angle tie brace plates. The continuous joint was used with twelve holes and two plates, with two holes for concealed bonding. In one of the pictures is shown the track-placing derrick laying out the heavy steel girder rails. From it can be seen the form and section of the girder rail.

CONCRETE BLOCKS PULLED OUT WITH DERRICK.

In much of the work, after the track had been lined up, a concrete stringer eighteen inches wide at the top and twenty-four inches at the bottom was placed so as to imbed the bottom of the ties and the foot of each rail. Crushed rock was tamped between the stringers to the top of the ties. The red rock used for tamping is a radiolerian chert that is easily quarried at Land's End, along the right of way. At first the rock was shoveled by hand into cars and hauled to the places needed, being dumped as shown in one of the views. Later, an electric shovel was tried and found to give more rock at less cost. This shovel consisted of a railway derrick car, equipped with ¾-yard scoop shovel fastened to a pivoted arm, and took the place of a gang of men. Current was taken direct from the trolley wire to the motor. One man loosened the rock and one man ran the machine. This chert is a sedimentary rock, filled with the siliceous skeletons of radioleria, minute free swimming animals. It is both argillaceous and siliceous, and is unexcelled for the purpose. In some work with basalt block paving, no stringers were laid, but solid concrete to a depth of one inch above the ties. A two-inch cushion of sand on this supported the basalt blocks, which were grouted with asphalt and gravel. In the asphalt paving, basalt block toothing was next placed against the rails on both sides, being filled in with concrete within two inches of the surface. The job was finished by a two-inch covering of asphalt. All concrete and paving work was under the supervision of a separate department. The company is required to place and maintain the pavement for two feet outside either rail. No mixing machines were used, the work being done by hand, on the street.

Double tracks of standard gauge, 4 feet 8½ inches, are laid throughout the city. A space of six feet is maintained between the tracks, except on Market, which has seven feet. The tracks were not welded, as such has not proved successful in this work. All crossings, frogs and switches were of guarantee construction, having been cast in the East with hardened points of manganese steel.

This work is still in progress. One track has been finished on McAllister from Market to Devisadero, and the other will be fixed next. An attempt to shear these rails by hand has proven unsuccessful. Market Street, from Twelfth to Castro, and from Sutter to the ferries, has been finished, the latter task requiring special comment. East Street is two feet below grade, and is to be rebuilt, as was done on Market Street.

DERRICK AND RING METHOD.

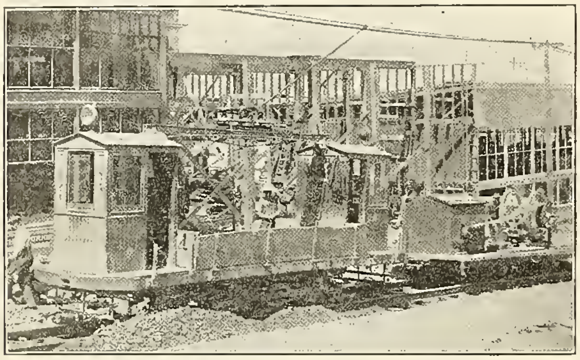
Mr. S. L. Foster, chief electrician of the United Railroads of San Francisco, furnished the following data on overhead trolley construction:

The standard type is the side-pole, span-wire. On Pacific Street, and on outer Fulton, beyond Twenty-fourth Avenue, can be seen samples of the latest standard work. Three-section, tubular-steel, 30-foot poles of standard 6-inch, 7-inch, 8-inch pipe, with 18-inch sweged joint insertions, are set in concrete, in pairs, one on one side and its mate on the opposite side of the street, these pairs being spaced about 110 feet apart, longitudinally. There have been inherited from constituent companies fourteen different kinds of steel poles which are in use on the system at present, to suit the different conditions of street widths, curves and feeder cable strains. These vary in capacity from 350 pounds safe load to 15,000 pounds, but have recently been reduced to three-section, 5-inch, 6-inch, 7-inch and 6-inch, 7-inch, 8-inch standard pipe and 6-inch, 7-inch, 8-inch extra heavy pipe. The standard side poles are set six feet in the ground, in blocks of concrete about 24 inches square, and are "raked" or leaned away from the direct or resultant line of stress, so that when a load not exceeding the elastic limit of the metal is applied, the pole will be pulled up nearly plumb.

These poles are free of ornamentation, so as to be as unobtrusive as possible and to be free from secluded points of oxidization so active in the San Francisco climate, which

often result in poles breaking off, not only at the base, but even at upper joints when corroded under ornamental bases or bands. Between opposite poles of each pair is stretched the ⅜-inch, 7-strand extra-galvanized steel span-wire attached to the pole by a ¼-inch by 2-inch wrought iron pole band, and insulated from the pole by two porcelain strain insulators, one next to the pole and one six feet from it.

This pole is one of the largest and most expensive side poles used for the purpose. The ⅜-inch span-wire is also the largest used, and has a breaking strength of 5,000 pounds. The use of porcelain insulators in span-wire work is unique, and originated on the trolley lines of the United Railroads in 1901. Various galvanized single and double links were devised to permit the rapid and workmanlike incorporation of this type of insulator in the trolley construction. These insulators have proven to be excellent for moist atmospheric conditions. They are cheap and incombustible; they have high compressive strength, are tough, and their electrical and physical condition is easily seen by the linemen. Their use on the system is one of the reasons for the marvelous rapidity with which the trolley service was re-established after the great fire in 1906. Composition strain insulators melted under the heat, whereas most of the glass and porcelain ones passed through the ordeal intact.



ROCK CRUSHER ON CARS.

ROLLING BALLAST.

The two insulators at each end of the span-wire prevent other wires falling on "grounded" span-wires, and conform to the requirements of the local ordinance that all guy-wires shall be insulated at each end at a point not more than eight nor less than four feet from the pole. With the usual insulation at the trolley wire, this gives three insulations between the live trolley wire and the steel pole, whereas the National Code only specifies two insulations on span-wires.

The trolley wire is 00 B. & S. hard-drawn copper, bought of specified tensile strength. This is as large round trolley as is used in strictly city work.

It is fastened to the span-wire by "clinched" ears constructed according to special designs of the United Railroads engineers, being modeled after the ear of the Boston Elevated Co. They are cast of a composition of metal specified by the purchasing agent. They have greater thickness in the middle and greater lip length at the center of the ear than at the ends, thus securing easier entrance and exit for the rolling trolley wheel, reduced hammer blow and longer life for wire and ear. The clinched ear is used in preference to the soldered ear as being cheaper to buy and put up, being independent of weather and skilled labor. It leaves the temper of the hard-drawn trolley wire unannealed at a point of maximum wear, and is more readily replaced when worn. On straight-line work, "one-piece" or "round-top" straight-line hangers with ¾-inch studs are used to attach the ear to the span-wire and insulate the two from each other. On curve work the "cap and cone" form of insulation with ¾-inch stud is used, it being the best form to withstand the blows from occasional wild trolley poles.

All the overhead metal parts used by the United Railroads are heavily galvanized on account of the fog. With galvanized span-wire there is no "local" action, but when brass parts were used they constituted a galvanic couple that quickly destroyed the iron wire. Solid bronze wire, tried on the brass parts to obviate this corrosion, failed under blows or from crystallization due to repeated flexures. Consequently, the galvanized malleable cast-iron parts with galvanized flexible stranded span-wire has been found best adapted to the conditions.

When the steel side-poles have been set and the span-wires stretched, the electric construction car, with a mile reel of trolley wire aboard, goes along the street, paying out the trolley wire and receiving current from it for its motors at the same time. As each span-wire is passed the trolley is fastened to it temporarily by a "tie" wire. When the end is reached, the full length of trolley is pulled up and anchored. On the car's return trip the ears and hangers are put on, the trolley wire "plumbed" to be directly over the center of the track, and the line is ready for service.

On curves, in the absence of the car to be used, calculations are made to ensure minimum friction between trolley wheel and wire. These calculations involve considerations of the radius of curvature and elevation of outer rails, wheel base of trucks, car body, king-pin centers, height of car roof, length of trolley pole, location of trolley-pole base, and height of trolley wire above the rail. These figures have been prepared by the company's engineers, so as to cover all standard radii of curvatures and all existing types of cars on the system, assuming the average height of the trolley wire to be nineteen feet. The elevation of the outer rail has to be considered separately when occasion arises.

For a 50-foot suburban car, on a 50-foot curve, the trolley should be 49½ inches off the center, towards the inside of the curve. For a 7-foot wheel-base, single-truck car, it need be moved but 14½ inches to secure the same results of making the "projection" of the trolley pole on the plane of the trolley wire a true tangent to the curved trolley wire.

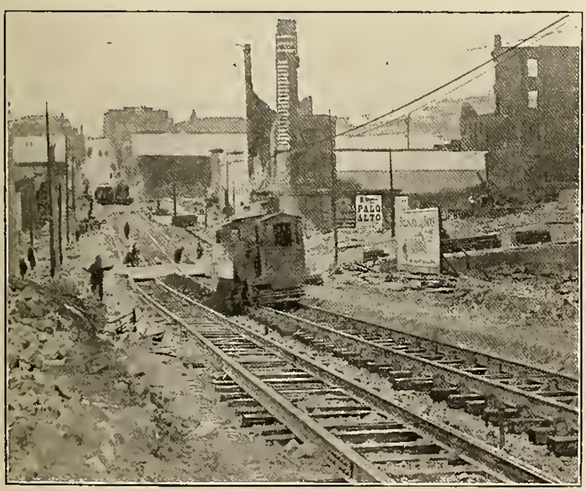
The spacing of the ears on curves has also been carefully calculated, so as to have the same departure from a

true curve between ears. The basis of these calculations is a spacing of 9 feet on a 50-foot curve, or a standard middle ordinate of 2½ inches at the center between successive ears on the curve.

Intersecting trolley lines are usually insulated from each other, both at right-angle crossings and in the curves, so as to keep different streets entirely independent of one another and under separate control from the power house.

PLACING RAILS.

On the system of the United Railroads, power distribution is accomplished entirely through overhead copper cables, though the company is now engaged in installing underground ducts for future underground feeders as it reconstructs its new lines. On Mission, from Sixth to Second, and on Market, from East to First, as the track was reconstructed, complete underground construction of ducts, manholes and laterals installed, terra cotta ducts have been



DUMPING TAMPING.

adopted as standard, and are laid in single-duct formation, surrounded by three inches of concrete. Elliptical manholes, placed at intervals of 400 feet, are connected with the sewers by terra cotta drain pipe.

The direct-current, 500-volt, overhead feeders differ in size, but the standards are 500,000 C. M. and 1,000,000 C. M. concentric-laid triple-braid weatherproof copper. From these feeders, which are calculated on a basis of a maximum loss of about ten per cent, the current passes to the trolley wire through No. 0000 B. & S. flexible-stranded double-braid weatherproof copper cable at intervals of from 500 to 1,000 feet. Frequent "feed-ins" and "cross-feeds" between the two trolley wires of parallel tracks are found desirable in order to secure uniform distribution and even voltage, and also to reduce the amount of trolley wire that is annealed when a break occurs and the trolley comes in contact with the rail, getting heated and softened by excessive flow of current.

The many miles of trolley wire in place on the United Railroads are divided up into seventy independent sections, each having separate feed wire and feeder panel at the power house, so that a falling trolley wire on one section interferes in no wise with the car traffic on another, and in case of trouble the power house operator knows at once exactly where to send the repair men.

There is much "tie" feeder copper between the different power houses and sub-stations, so as to promote continuous operation of all the cars, even in case of break-down at one source of power. Miles of bare 1,000,000 C. M. copper cables

COMPLETED TRACK.

are buried in the ground, radiating from the various substations to reduce the loss in the return path of the current and to remove the danger of electrolytic destruction of the pipes of the water and gas companies, there being over two and one-half miles of this heavy negative cable installed for use in connection with the Turk and Fillmore Streets substation alone. It is hardly necessary to admit that after the destruction wrought by the great fire of 1906 and the persistent annoyances of two successive linemen's and carmen's strikes of 1906 and 1907, everything has not yet been brought up to the ideal which has been set as a standard.

(To be continued.)

TRADE CATALOGUES.

Brochure No. 55, from the Weber Gas Engine Company, of Kansas City, Mo., is filled with information on the Weber Engine.

Bulletin No. 304-B, displacing 304-A, from the Holtzer-Cabot Electric Co., of Brookline, Mass., contains much interesting data on single-phase alternating-current motors, incidentally showing the advantages of this make. No. 302-A is devoted to their special type "M" motor-generators, three-bearing type, designed to give the highest possible output per unit of space. Type "SS" motors, one-eighth and one-sixth-horsepower direct-current, are portrayed in No. 313, and type "C" motors and dynamos, direct-current, in No. 314.

GAS-ENGINE REGULATION.*

By Charles E. Lucke.

The four-cycle gas engine may be regulated by the hit-and-miss governor, which is out of the question for close regulation since there is absolutely no attempt to graduate the effort. Next, there are throttling governors, which vary the amount of mixture by throttling the suction. There are others which admit a full charge during suction and expel part of it at compression by holding the valve open. Still another class, including oil-engines like the Diesel and Hornsby, admit fuel at or near the end of compression, and govern by varying either by the time of the injection or its length, generally the latter. Two-cycle gas engines of the Korting type may govern by acting on the suction of the gas pump with a throttle or delayed closure by any of the devices used on four-cycle engines, or it may govern by bleeding the charge in the gas chamber between the pump and motor cylinder. In both two- and four-cycle engines there may be an adjustment of the igniter. For reducing the time that will elapse between the valve movement and the beginning of a new effort the action should take place as late as possible in the cycle, which will give the effect as early as possible in point of time. For this reason a delayed opening on suction will be better than suction-throttling by a fraction of a stroke, and correspondingly the igniter action will be as prompt as affecting the admission as the steam engine. Equally prompt would be a fuel injection into compressed air at or near the end. No gas engine uses this. Unfortunately, however, for any igniter action, even a slight change will affect the economy and the range is practically in only one direction. If the igniter is set right for economy, governor action can take place only to make it late and not to make it earlier with the proper effect. Making it late will reduce the effort, and so will making it early, whereas an increase in effort is necessary in using this arrangement for regulating. In order to have a proper range for regulation by the ignition, the ignition should be normally set between properly early and very late, which gives poor economy. In any case where ignition is not used, as the beginning of a new effort, it may be assumed to take place on the beginning of combustion or the expansion stroke; the entire compression more or less must elapse between the valve gear at the charge and this beginning of combustion, a little less than a complete compression for delayed closure of the suction valve and a little more for the throttling action. In general it seems impossible to reduce the cycle of time to less than one stroke.

With this cyclic time it is useless to attempt to govern closely any engine with less than two double-acting, four-cycle cylinders, or one double-acting, two-cycle cylinder. It is useless to put a very sensitive governor or one of the highly refined inertia type on an engine that has been proved to be not worthy of it in the above mentioned respects.

Examination of a number of valuable papers on some of the phases of this regulation problem that are common to steam engines shows that we may have many kinds of load, effort, governors and valve gears.

To study adequately all the conditions appearing in this summary, including the unusually large number of variables under the five groups, more or less dependent, is a very tedious matter, but nevertheless worth while. From the large number of turning-effort diagrams, steam and gas engines, the nature of this effort-curve and its change with load, cylinder combinations, grouping of crank-angles, different inertias and reciprocating parts, have become fairly well known. To those not familiar with such turning-effort diagrams of gas engines, reference may be had to Guldner, Haeder, Lucke, and numerous papers. A comparison of the gas engine, turning-effort diagram with that of the steam engine will show that it is possible to secure as regular an effort curve for the gas engine as for the steam engine; regular with respect to the number of fluctuations above or below the mean, and with respect to the value of the co-efficient of fluctuation. That is to say, that the turning-effort diagrams for the gas and steam engine are equally good as computed under the constant load condition, and this is the only basis on which they have been computed. What happens when the load changes and before the governor has had time to balance the effort with resistance, will be different for the two classes of engine and different again for individual examples of each class.

There is no use in attempting to regulate a gas engine that will not meet the first requirement of absolutely invariable indicator card with the valve-gear blocked in position. This is the first difference between the problem of regulating the gas engine and the steam engine, and must be checked. Only the best gas engines will give such invariable cards. The next step is to run the governor with all valve-gear connected, but with the engine at rest, the governor being driven from an external source to determine valve-gear positions at different speeds of the governor. This requires very accurate speed-measuring apparatus. The next experimental check is to measure the mean effective pressure obtainable at all different positions of the valve-gear, it being blocked during measurements, and the engine held to about the proper speed with suitable resistance and the governor cut out. From this the speed horsepower curve should be plotted, and there must be not too small a difference between mean speed at constant full load and the same at constant no load. The result should be checked by operating the engine with everything connected and a variable load. Every precaution should be taken to insure the governor operating valve from sticking either by tar or dust collection. The next important difference between the steam engine and gas engine regulation will come in as the result of cyclic interference in each. This requires calculation and experimental check to obtain proper data on the necessary sensitiveness and type of governor fly-wheel effect, which should neither be too much nor too little in the light of the operation requirements.

Failures to obtain proper regulation of gas engines from any of the cases mentioned, but chiefly from cyclic interference, have been overcome or rather avoided by the introduction of flexible couplings, consisting of leather link, spring, friction slip joints, centrifugal devices, all of which are intended to allow the driven rotor to move at a uniform speed, even though that of the driving engine should fluctuate. These devices have never been used on large units and are by no means solutions.

Large gas engines are operated fairly satisfactory with twenty-five cycle alternators and the cyclic interference, while it is always noticeable, is not prohibitively bad. With 60-cycle work this is not the case, and gas-engine-driven, 60-cycle alternators must be so far pronounced unsatisfactory, though some are doing well. Considering the nature of the problem, its newness, its difficulty, and the more insistent demands of the public for economy of fuel, and ruggedness of construction than for close regulation up to the present time, I think that the gas engine has done extremely well. The wonder is, then, not that the gas engine cannot regulate as well as the steam engine, but that it regulates as well as it does. In the light of all this I feel that the gas engine has only just started on its career of usefulness.

In conclusion, I believe that an intelligent examination of the nature of the problem of gas-engine regulation and the study of numerous diagrams, force and velocity, of the kind here presented, will result in the elimination of many of the present handicaps of the gas-engine cycle and make possible regulation as good as that of the steam engine.

*Abstract from paper presented at the meeting of the Boston Branch of American Institute of Electrical Engineers, January 9, 1907.

CURRENT COMMENT

The specific heat of steam is about one-half that of water, and consequently its temperature will be raised twice as much as that of water by applying the same amount of heat.

The Tokyo electric railway is to be taken over by the municipality on March 31, the price being $38,750,000, to be paid in municipal bonds, bearing six per cent interest and redeemed in installments within twenty-seven years.

Selective party line operation of telephones may be obtained by using ringers with armatures that respond only to the proper frequency ringing current. By means of a converter alternating current can be delivered at any one of four cycles that will call or ring on a four-party line without sounding the others.

One kilowatt-hour will supply a 16-candlepower lamp consuming three and one-half watts per hour for eighteen hours. It will lift one ton to a height of 1,103 feet, or drive a ten-ton electric car over a distance of about three-fourths of a mile at a speed of eight miles per hour, varying with the number of stops per hour.

A high-pressure turbo-compressor has been devised by M. Rateau that is analogous to the centrifugal pump that bears his name. Cooling water is introduced into the partitions and diffuser vanes. As compared with the reciprocating compressor, compression is more nearly isothermal, and air is supplied regularly, instead of pulsating. It occupies much space, eliminates vibration, and is cheaper in operation.

At Nelson, B. C., the Canada Zinc Company is almost ready to operate its plant for electric reduction of zinc, the first of its kind on the continent, although a similar plant is working successfully in Sweden. At the present time, much of the lead ore of the Slocan occurs with zinc, and a penalty is demanded by the smelters for zinc units when over ten per cent. This frequently means that the lead mine cannot be operated because of the zinc penalty, and because no values are obtainable for the zinc.

Telephones equipped with service meters that are operated by the subscriber when the desired number is obtained obviate nickel-in-the-slot machines. A counter in plain view shows the record so that the user at all times knows the status of his account with the operating company. The registry is made by pressing a vibrator that also informs the central operator, so that it is impossible to signal without registering. As the device is located at the subscriber's station all registrations are made by him, and there is no possibility of his being charged with calls from other lines.

The Chilean Government has commissioned an American electrical engineer to study the feasibility of changing the first and second sections of the State railways for the use of electrical instead of steam power. The first section connects Valparaiso with Santiago, and is about one hundred miles long, and the second sections extends from Santiago to Conception, and is about three hundred and fifty miles in length. Double track is being laid on the first section. At present the coal bills for the State railways are heavy, since a large proportion of the coal used is imported at a high cost.

The Inland Waterways Commission, appointed by President Roosevelt, is said to be preparing a report in advocacy of Government conservation of waterpower. Early action on this subject will be urged, on the ground that the big electric and railroad companies of the country are attempting to forestall action by the Government. The commission will hold that the Government can control the waterpower on all public lands and also in all navigable rivers of the country. It was on this theory that the waterpower rights at Niagara Falls were apportioned by the Secretary of War last year.

Experiments recently made by Camille Flammarion, in Paris, show that under the effects of red light certain vegetables, such as lettuce, grew fifteen times as fast as under blue light. On the other hand, blue light has remarkable preservative powers. An oak tree planted two years ago has kept its first leaves, which are now as fresh and vigorous as when they first appeared. In the same way, ripe fruit, it is declared, can be kept fresh under a blue screen for twenty days without decay. The strawberry plant can be retarded for a similar period and then allowed to fructify. The experiments are expected to have a wide application to market gardening.

Tantalum has a specific gravity of 16.8, and is heavier than any common metal except gold and platinum, being much heavier than silver, lead or mercury. The only acid which will attack it is hydrofluoric, and then only when heated. It unites with hydrogen and nitrogen, even at low red heat, forming brittle metalloidal compounds. It also unites with carbon, to form carbides. The pure metal is as hard as mild steel, and a little darker than platinum. It is obtained in the metallic state by reduction of the double fluoride, $K_2Ta\ F_7$, by metallic sodium, and the resulting metal is repurified by heating in a vacuum. The metal can also be obtained by igniting the brown tetroxide of tantalum as a filament in a vacuum.

Vice-Consul-General Robert B. Jones, of Guayaquil, makes the following report on the street car systems of that Ecuadorian port: The Board of Directors of the Guayaquil Tramway Company, a mule car line, announces that on January 1, 1908, its capital stock will be increased from $250,000 to $375,000 United States currency. Up to the present time, this company has had a monopoly of the street car business of this city, and for some years past has paid to its stockholders about twenty per cent annually in dividends. The increase in the capital stock will be effected by calling in and canceling the present certificates of stock and issuing new certificates to the holders thereof, who will receive three shares of the new stock for each two shares of the old. Work on the new electric street car line has been resumed, and is being pushed to completion as rapidly as possible. It is expected that a portion of it will be in operation early in 1908. The charter for this line was granted by the city some months ago, to an independent company. It is believed that eventually the new company will either absorb the old company or be absorbed by it, and that the whole system will then be electrified.

An Austrian has invented an electric rat-killing device that should appeal to a Board of Health fighting bubonic plague. According to the "Scientific American," it consists of several rows of metal points arranged a short distance apart beside each other, connected partly to the positive and partly to the negative terminals of an electric high-tension circuit. The animal, on coming into contact with these points, is killed by the electric shock; the point effect at the contact with the animal causing the electric current to enter the interior of the body. Between the several rows of points there is placed a bait to attract the animals to be caught. The points are arranged inside of a vessel provided with an elevated edge, so that the victims, after being electrocuted and thrown aside, remain in the vessel. The apparatus is designed to be readily lowered into drain pipes, etc., in order afterward to be removed along with the killed animals. According to reports in the Austrian press, experiments have been made on this apparatus at the electric factory of Signor Galatti at Trieste with exceedingly satisfactory results. It is said that the apparatus is so designed as to kill only rats and similar vermin, while in no way endangering domesticated animals.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX FEBRUARY 15, 1908 No. 7

EDITORIAL.

ELECTRICITY FOR THE FARMER.

Luther Burbank says that you can change the nature of a plant only by changing its environment. It is the same with man. There is probably no single factor that has done, and is doing, more to change his environment than electricity. This is particularly noticeable with the intelligent farmer of the present when compared with the agrarian of the past. He is surrounded with books and papers that tell him today what the world did yesterday. He can go to the city quickly, safely and cheaply in an electric car. He need never be lonely, for the telephone puts him in instant communication with his neighbors. These lift out of the narrow rut of provincialism, and energize into a reasoning, thinking being, what might otherwise be a mere clod. But this metamorphosis is yet in its preliminary stages. Even today there are those who would tickle the ground with a hoe and expect it to laugh with a harvest. Progress requires initiative. These conveniences already named have been given by others. Installing electric lights in the home and barn is but a step in the right direction. He has not lived to the full measure of his ability who owns, but does not create.

The many labor saving applications of motor drive to chores and cultivation requires the exercise of some ingenuity. We have seen fields figuratively furrowed by a net work of wires carrying potential power that has never been tapped for the farmer's use. The vagaries of the wind are relied on for pumping, a horse whim is used for stacking and baling hay, and the hired man cuts wood and chops feed. Any and all of these could be done better and quicker with an electric motor. The wind either does not blow when needed, or blows too hard and destroys the mill. The feed and shoeing of a team has been estimated to cost $466 a year, while the repair and replacement of harness together with time spent in caring for the animal add at least $34, making a total of $500. It costs as much to hire and keep a man. A motor only consumes current when working, and is never sick. The women folks also will need less help and have more time if their churning, washing, ironing and sewing are done by electric power. The work of caring for lamps and stoves and of preparing the fuel is unnecessary with electric lighting, heating and cooking.

Heretofore, the main argument in favor of the horse has been his flexibility. The same beast can be used for hauling, plowing and driving machinery, and convenience in this respect has offset a greater cost of power. A California ranch of one hundred acres needs about five horses to do the work, which can be done cheaper with four portable motors that can be belted up in less time than it takes to harness a team of horses. In other lines of work the electric motor has proved to be the most flexible power possible.

In this country steam harvesters and threshers are no more successful than would be electric. In Germany plowing and cultivating are regularly done with implements hauled by electric driven cables. In Italy seven and a half acres are plowed to a depth of six inches in ten hours with a 15-horsepower motor. In France and Switzerland, where water is abundant, the farmer generates his own current. On this Pacific Coast water for irrigation comes from the mountains. Why should not the power?

We have devoted our discussion to practical actualities without investigating the demonstrated merits of electric forcing of plant growth for a profitable out-of-season market by soil electrolysis and artificial arc-lighting in hot-houses. We have not dwelt in the pregnant possibilities of electric incubation. We have not shown how valuable products may be saved from blighting frost and impending storm by working at night with electric light. These weather forecasts, by the way, are now communicated to the farmer by telephone or telegraph long enough in advance to give ample warning. Italian wines are now artificially "aged" by electrolysis, and a fine bouquet is produced by the liberation of nascent oxygen. Electric bleaching of beet sugar offers great possibilities. No inspector could condemn milk from an electrically-clipped cow, housed in an electrically-lighted barn, fed with forage chopped by an electric motor, and milked by an electric milking machine, especially if the milk, and mayhap water, be electrically sterilized.

We will not exhaust the subject by dwelling on a recently patented electric rat and insect killer, but leave to our readers the pleasures of these day dreams that will soon materialize.

But there is one fact that our heedless farmers will realize all too soon, and that is the impoverishment of the soil resulting from export farming. Some form of nitrogenous fertilizer must needs be added even to the rich soil of the West. While natural fertilizers are all but exhausted, artificial ones are now cheaply produced electrically. We refer to calcium cyanamide, which is produced in large quantities by passing nitrogen over heated calcium carbide, a product of the electric furnace already familiar to those using acetylene lighting. Thus does science aid Nature.

The position of the central station manager here is much like that of the butcher who puts in expensive refrigerating plants and pays high freight bills to sell meat in a distant market while his neighbors are living on salt pork and embalmed beef. This field has lain fallow for a long time. It can be easily cultivated at odd times, so as not to interfere with the other work of the station. Little farm work is done during peak load, and the curve can be equalized in no better way. With these conditions a rate can be offered low enough to attract the farmers, who will also prove the truth of the adage, "the more he gets the more he wants." The profits from No. 1 hard at fifteen bushels per acre, are insignificant in comparison.

WYNN MEREDITH WITH SANDERSON & PORTER.

Wynn Meredith has become a member of the well-known firm of Sanderson & Porter, electrical engineers, of New York City, having severed his connection with Hunt, Dillman, Meredith & Allen. Mr. Meredith will handle the Western business of Sanderson & Porter, with headquarters in the Union Trust Building, San Francisco. This company has done the engineering and construction for many electric enterprises in the Northwest, including the Spokane Inland Railway system. They also have charge of the Stanislaus Power Co.'s installation, which will be rushed to completion as soon as possible, as all arrangements for financing it have been completed. Mr. Meredith needs no introduction other than the excellence of his work, as shown in the construction of power plants from British Columbia to Mexico. His recognized standing as an engineer and his executive ability as a constructor is stated to be second to none on the Coast. This is witnessed by the installation of the Vancouver Power Co. As described in the "Journal of Electricity, Power and Gas," of January and February, 1906, it included the dam at the outlet of Coquitlan Lake for storage, a 2.21-mile tunnel connecting Coquitlan with Trout Lake, the dam at the latter, the pipe line and the power house, all of which was executed under his direction.

PUBLICATIONS RECEIVED.

The following papers and discussions appear in the February, 1908, Proceedings of the American Institute of Electrical Engineers: Gas Engine Regulation for Direct-Connected Units, by Charles E. Lucke. The Non-Synchronous Generator in Central Station and Other Work, by W. L. Waters. Some Developments in Synchronous Converters, by Charles W. Stone. Some Features of Railway Converter Design and Operation, by J. E. Woodbridge. Discussion on "Comparative Performance of Steam and Electric Locomotives." Discussion on "High-Tension Transmission." Discussion on "Proposed Code of Ethics."

The Proceedings of the American Society of Mechanical Engineers for February, 1908, contains its usual quota of Society notes, including the first chapter on the History of the A. S. M. E. The papers printed are: "A Simple Method of Cleaning Gas Conduits," by W. D. Mount, and "A Rational Method of Checking Conical Pistons for Stress," by Prof. Geo. H. Shepard. Contributed discussion on a number of gas engine papers conclude the issue.

TRADE CATALOGUES.

Bulletin 501, from De Laval Steam Turbine Company, of Trenton, N. J., illustrates and describes their turbine engines, separate or driving dynamos and blowers; also centrifugal pumps, turbine or motor driven.

The Electric Journal sends a copy of their new Four-Year Topical Index. This index contains, in convenient form, references to all of the important engineering articles which have appeared in the issues of the Electric Journal from the first issue to date.

The Western Electrical Instrument Co., of Newark, N. J., send circulars of the new Weston A. C. Switchboard Instruments and of the new Weston Eclipse D. C. Switchboard Voltmeters and Ammeters, which will interest all central station men and switchboard users.

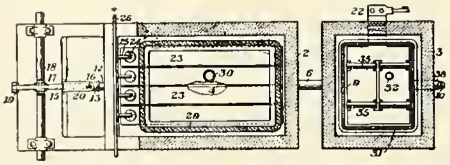
Westinghouse Circular, No. 1104, from the Westinghouse Electric and Manufacturing Company, shows their entire line of portable meters. The circular is well illustrated, with exterior and interior views. The large number of connection diagrams employed fully illustrates the application and use of meters for measuring the various classes of single and polyphase circuits, which should prove of value to engineers called upon to do this class of testing. The testing of service type integrating wattmeters by means of the portable integrating test meter has received special attention, and should prove of interest to central-station meter men. A complete index is employed, thus permitting ready reference to any desired subject.

In Bulletin No. 4559, the General Electric Company, Schenectady, N. Y., describes lines of motor-starting rheostats and panels for direct current. In order to facilitate the installation of motor-starting devices, the General Electric Company has perfected a line of motor-starting panels in which there is no multiplicity of the terminals to give trouble from bad or incorrect connections; space, labor and time are saved; maintenance is reduced, and satisfactory operation, immediate and permanent, is obtained. The bulletin shows a variety of these panels in which different types of starting rheostats are used, the rheostat being combined with a line switch and fuses, or with a double-pole circuit breaker. Dimension diagrams for the different capacities of rheostats and panels are included.

PATENTS

METHOD OF ELECTROLYZING SALTS. 877,537. Jasper Whiting, Niagara Falls, N. Y.

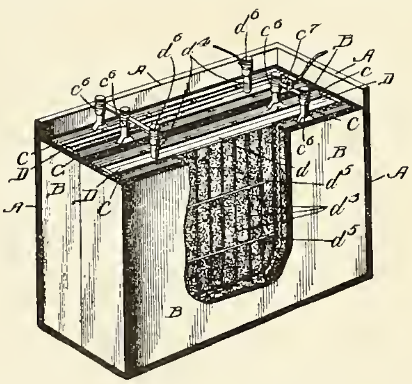
The method of effecting electrolytic decomposition of salts, consisting in passing an electric current through the electrolyte to a mass of liquid metal, and maintaining substantially the same mass of liquid metal as a cathode for a



period of time, then, while maintaining a body of electrolyte in the decomposing chamber, withdrawing the mass of liquid metal, and replacing it with a fresh mass of liquid metal, the same angular relation between the adjacent surfaces of the electrodes being maintained throughout the cycle of operations.

STORAGE BATTERY. 877,889. William Gardiner, Chicago, Ill., assignor to Commercial Storage Battery Co., Chicago, Ill.

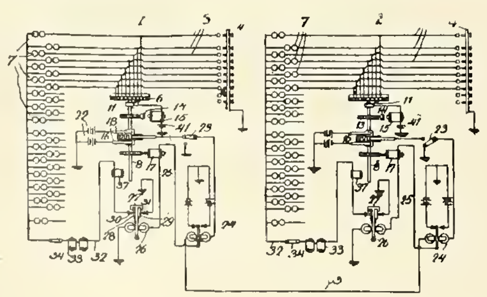
A grid comprising oppositely disposed series of horizontal containing bars of a triangular cross-section set with



apex outward, and a series of oppositely disposed vertical strengthening bars, each bar being provided with a series of inwardly flaring lugs or teeth, the teeth of oppositely disposed bars being in staggered relation to each other.

PRINTING-TELEGRAPH. 877,822. John C. Barclay, New York, N. Y.

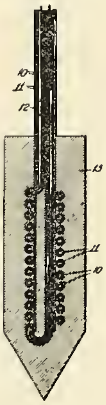
A printing telegraph comprising in combination trans-



mitting means including pulsatory-current producing means arranged to produce periodic current pulses in a line and means for prolonging at will any one of such pulses; a line circuit; and receiving means including a plurality of character-magnets corresponding each to a different character, and corresponding in number to the characters to be printed, one or another of said magnets adapted singly to cause the printing of any one of such characters, a sunflower selector comprising contacts for the different character magnets, and a separator relay controlled by the line circuit and controlling the circuits through said sunflower to the several character magnets and arranged when operated by a prolonged pulse to cause the character magnet in circuit at that instant through the sunflower to operate.

ELECTRIC HEATER. 877,843. Edmund F. Hoskins, Evanston, Ill., assignor to The Hoskins Company, Chicago, Ill.

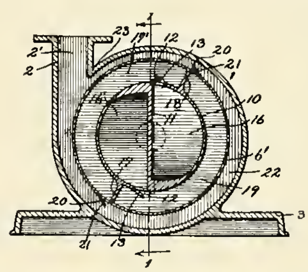
An electric heater, comprising, in combination, a handle-stem, a coiled insulated resistance-wire on stem, and having



its ends extended along the same forming terminals, and a metal heat-transmitting head cast about wire in intimate contact with the insulation thereon.

CENTRIFUGAL PUMP. 877,484. Everett W. Brooks, Chicago, Ill.

In a compound-piston centrifugal pump, the combination of a suitable main casing and a compound piston journaled to rotate therein, said piston being internally subdivided to form alternate chamber-passages the flow-direction through each of which is substantially non-radial, and port passages the flow-direction through which is radial,



port passages being arranged to afford communication between successive chamber passages and between the latter and the discharge space outside the piston and within the casing, one or more radially extending impelling walls in the primary chamber or chambers and suitable radially extending impelling walls in one or more of the succeeding chambers.

INDUSTRIAL

MULTIPLE LUMINOUS ARC LAMP.

The luminous metallic arc is recognized as one of the most efficient and best all-around street illumination in commercial use. This system of street lighting having passed the experimental stage, is now in quite general use. For low voltage, direct current multiple circuits, however, there has been but little use made of the luminous arc lamp.

The General Electric Company has now on the market a luminous arc lamp for operation in multiple on direct current circuits of from 100 to 125 volts. The general form of this lamp can be seen by referring to Fig. 1. The casing is of solid copper, with a black oxidized finish and of sufficient thickness to form a durable housing for the lamp mechanism, as well as a substantial support for the outer globe and its supporting ring.

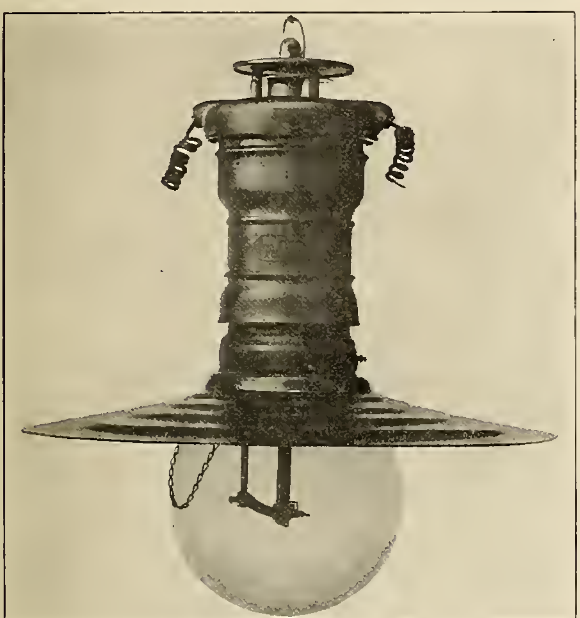


FIG 1.

Figure 2 is an interior view, showing the mechanical construction of the lamp. The main frame consists of a 1½-inch iron pipe connecting the top and bottom castings. This method gives a rigid construction, and at the same time provides a suitable center draft or chimney for disposal of the arc fumes. At the top this chimney is protected from rain and snow in such a manner as not to interfere in any way with the natural and uniform draught required for the proper action of the arc.

The upper or positive electrode consists of a drop forging of copper. With a large volume of copper and a large radiating surface, it is possible to keep this electrode at a low temperature. This condition, together with the peculiar characteristics of the luminous arc, results in a slow wearing away of the copper. The copper electrode in a 4-ampere lamp will require renewal after about 1,800 hours operation; or with an average burning of 5 hours per day will last about one year.

The lower electrode which is responsible for the flaming characteristic of this lamp is an iron tube about ¾-inch in diameter filled with a prepared composition. One electrode only is used at each trimming, with a life of about 150 hours.

There are two single magnets, with two armatures mechanically connected. The action is positive, and at the same time remarkably sensitive, responding quickly to any variations of the line or arc, and thus maintaining a close regulation of the current.

In general, the lamp needs little attention; less in fact, than the enclosed lamp, as there are no enclosing globes and gas caps to require careful handling, cleaning and renewing. The luminous arc lamp is especially recommended for the lighting of foundries, machine shops, train sheds, freight houses, drill halls and riding academies.

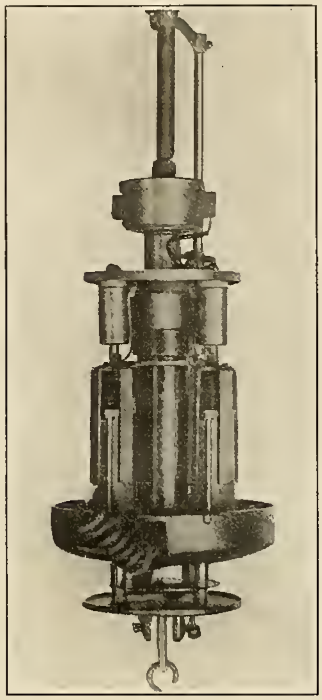


FIG. 2.

CARBON BRUSHES.

The use of carbon for dynamo brushes was suggested by Prof. G. Forbes in his patent of 1885. To-day the operation of street-railway motors and all machines on which the position of the brushes must be fixed, would not be practical without the use of carbon, as sparkless commutation at all loads is only possible when carbon brushes are used.

In the early days of manufacturing carbon for electrical purposes, a variety of materials and elaborate methods were required. To-day fewer raw materials are used, the methods are much simpler, and the finished carbon is much more reliable than heretofore. Formerly it was customary to imagine the process of manufacturing carbon a dark secret which was carefully guarded. Many manufacturers still hold to this idea, and watch their premises as if they were nursing some deep mystery whose rare value depends on secrecy. As a matter of fact, however, the manufacture of carbon, if it is to be a success, is a straight-forward business proposition which must be run on good business principles. Then, with proper care in procuring raw materials which come up to specifications, with powerful machinery for handling the mixes and forcing the carbon into desired shapes, with suitable kilns for carbonizing, the carbon product can compete with any turned out by factories of long standing which still

adhere to the methods of the alchemist guarding the secret acid which turns the base metal into gold.

To-day the use of carbon is larger than ever, as there is hardly a branch in the electrical field which does not require it in one form or another. Carbon for brush purposes forms one of the most important branches, and the manufacture of a good brush for street-railway use is a field in itself. A brush which will stand up and give good service in this work has been the object of the manufacturers for years. Such a brush must combine many qualities, for in no other service do brushes meet with such hard usage. In addition to electrical qualities, they must have many mechanical qualities also, for in this field they are subjected to severe mechanical stresses and strains accompanied by rapid variations in current and voltage.

Many street-railway brushes have been tried, but those most commonly used are composed chiefly of petroleum coke, a product of the distillation of crude petroleum, graphite, introduced for tempering and lubricating purposes, and refined hard pitch and heavy oils which act as bonds.

The petroleum coke, which is almost a pure carbon, comes from the oil refineries in large, porous lumps. These lumps are broken up in crushers to about the size of nut coal and then calcined in retorts until all volatile matter is driven off, losing thereby about thirty per cent of their weight. This calcined coke is then ground very fine, conveyed to bolting machines and only that part which passes through closely-woven silk is used in the brush mixes. This dust, in passing through bolters, is freed from any large particles of carbon or grit from the grinders, presence of which in the brushes would tend to cut the commutators. Up to a few years ago, natural graphite, a good grade of which comes from Mexico, was very largely used. Now, the graphite made at Niagara Falls has taken the place of the natural, to a large extent.

The finely-ground coke, graphite, pitch and oils, are carefully mixed in definite proportions and thoroughly kneaded in large steam-jacketed mixers designed for this purpose. The pitch is melted by the heat and the whole is worked together into a uniform plastic mass. This is put in moulds and pressed into shapes, called cheeses, which are then placed in powerful hydraulic presses capable of exerting a pressure of hundreds of tons.

These presses force out the cheese through dies into strips which are cut into lengths such as can be conveniently handled. These "green carbon" strips are packed in kilns which are fired for several days. For a day or two the kilns are fired very slowly, with open doors, but after the whole mass has been dried throughout, the temperature is gradually raised until there is an intense white heat in the kilns, which thoroughly carbonizes the pitch and oils which have served their purpose as bonds, leaving a homogeneous and uniform carbon. When the heat has been maintained a sufficient length of time, the kilns are hermetically sealed and allowed to cool down gradually, in order that the carbon will not be cracked by too sudden lowering of the temperature.

As soon as the kilns have cooled sufficiently, the carbon strips are removed, brushed off and are then ready for the finishing machines, which turn out the brushes into the various sizes required by the trade. Cutting these strips into brushes of the proper dimensions is not such a simple matter as it would seem; although a good carbon brush will slide over a commutator for a long period with very little, if any, cutting, yet if it is attempted to cut the carbon itself, the edge will be taken off the hardest steel in a very short time. The most efficient way of handling carbon is by grinding, and for this purpose carborundum or the diamond are the abrasives most successfully used, though even these must be constantly watched and frequently replaced.

Copper plating carbon on a large scale offers more difficulties and requires a great deal of thought and attention. Many electroplaters who have successfully plated the metals, fail in their attempts to deposit a permanent coating on carbon, for this material, being more or less porous, readily absorbs the plating solution. Unless this solution is removed from the carbon as soon as it is taken from the bath, the acids in it will creep out and destroy the plating.

The idea of plating brushes is to give them a good metallic contact with the holders. On generators and stationary motors, this works very well, but for railway motors, where there is constant rubbing of the brush on the holder, it is doubtful as to the benefit derived. Some claim that it is a disadvantage, as the copper generally wears off and occasionally it will roll up between the brush and holder, causing the brush to stick fast; this, of course, gives immediate trouble. Some of the largest systems in the country are to-day using an unplated brush in their motors, and claim better results thereby.

Modern street-railway service demands a uniform, close-grained, dense brush, free from cracks and flaws, hard enough to withstand the ordinary mechanical strains and jars which cannot be avoided in street-railway work. The brushes must offer sufficient contact resistance and be thick enough to allow the right amount of time to the act of commutation. The proper thickness of the brush is determined by the designer and builder, and the brush holders made accordingly. Care must be taken to see to it that in replacing the holders when worn out, that the original dimensions are strictly adhered to and the brushes used are not too thin.

To get good service from a brush, the following is necessary:

The commutator must be in good condition, free from high or loose bars, flat spots, grooves or ruts, etc.

Brush-holder rods must be firm and steady, so that the vibrating of the machine when running will not cause chattering of the brushes.

The brush holders must be properly spaced. This spacing should not be approximate, but exact, for it takes only a very slight displacement to cause sparking. A suitable gauge for checking the spacing of the brush holder is easily made, and should be on hand for each type of motor in service.

The spring tension must not be too great, for if this is the case, cutting will start and grooves will be formed.

The brushes must be snug in the holders. If too tight they will stick and cause arcing; if too loose, chattering and its consequent sparking.

The brush must not have too much inertia, as it must be free to rise and fall, so that it can follow the commutator should it for any reason be slightly elliptical.

Many motor troubles are attributed to the brushes, for which they are in no way responsible. This is due to the fact that trouble caused by weak or annealed springs, wrongly spaced brush holders, high bars, flat spots, short-circuited or open armature coils, etc., first show at the brushes in the form of chattering and sparking, arcing and flashing, or "bucking over." In many cases, brushes are expected to correct all motor troubles which naturally arise in railway service. Many of these troubles could be avoided or checked before serious consequences follow, if careful inspection and proper repairs were provided. Poor or defective brushes can cause trouble enough, but the best brush cannot fill all the requirements that are sometimes demanded of it. With careful inspection by one familiar with the principles upon which a street-railway motor is built and run, and good brushes properly fitted to the commutator at the start, many of the troubles commonly attributed to the brushes will disappear and increased efficiency of the motors and a reduction of the maintenance cost will be sure to follow.

The American Carbon & Battery Co., of East St. Louis, Ill., who for many years have been manufacturers of high-grade carbon brushes, have appointed Pierson, Roeding & Co., of San Francisco, Seattle and Los Angeles, their exclusive Pacific Coast agents.

NEWS NOTES

WATERWORKS.

Piedmont, Cal.—The Trustees have appropriated funds for the placing of 20 fire hydrants throughout the recently incorporated town.

Sonora, Cal.—The Experimental Gulch Mining Company is preparing to take up 2,000 feet of pipe line and to replace it with larger pipe.

Davis, Cal.—Plans have been completed for the water and sewer systems for the State dairy farm at this place and bids will be called for very soon.

San Diego, Cal.—At the last meeting of the Board of Public Works, the superintendent of the water department was authorized to buy 160 lengths of cast-iron mains.

Santa Clara, Cal.—W. M. Concannon, of San Francisco, has been awarded the contract for supplying material for the new water tower and tank for the city waterworks, at $994.

San Bernardino, Cal.—Bids are being received by the Board of Water Commissioners for the furnishing and delivery of 1,300 feet of 6-inch and 2,700 feet of 4-inch cast-iron pipe.

Azusa, Cal.—The City Trustees have awarded a contract for furnishing and laying 8-inch water pipe on Center Street, between Azusa and San Gabriel Avenues, to the B. R. Davidson Company, at 59 cents per foot.

Yuba, Cal.—The City Trustees have decided to take up the matter of supplying water for fire protection in this place. They will act in conjunction with C. B. Andross, who is to put in a waterworks system here.

Woodland, Cal.—The first carload of water pipe for the extension of the local water system arrived from Chicago a few days since and work on the authorized extensions will begin as soon as the weather settles.

Searchlight, Nev.—A seven-mile pipe line is about completed from Budweiser Springs to the Orange Blossom Extension mines near here, and it is now proposed to extend the line ten miles further and secure additional water supplies.

Vallejo, Cal.—Acting on legal advice given last week, the Board of Trustees has decided to recede from its former position and go ahead with the laying of the seven-mile pipe line for the municipal water system. D. H. Fleming, of this place, has the contract for laying the pipe.

San Francisco, Cal.—The Fairfax Villa Company, owner of several hundred acres of land back of Fairfax Park, has bonded this property to the Fairfax Water Company for $165,000. The latter company is understood to be in favor of laying a water system into southern Marin County in competition with the companies now operating there.

Oakland, Cal.—The City Council will within the next week or two take up the matter of fixing the rates for the ensuing year. The matter has been left largely in the hands of Chairman Pendleton, who last year succeeded in getting the company to acquiesce in a ten per cent reduction to private parties and a twenty per cent reduction to the city, thus avoiding the usual litigation on the subject. The cut made a year ago is figured as having effected a total saving to consumers of about $125,000.

Pasadena, Cal.—The City Council has accepted a report from a committee showing the amount of improvements to the plant of the West Side Water Company which will be necessary in case it is voted to issue the necessary bonds. The itemized list is as follows: New street mains, $14,042; meters, $4,001; water-level gauge, $135; water-testing plant, $97; pumping plant at Sheep Corral Springs, $8,358; pumping plant at Glenarm Street, $488; Grand Avenue pump house, $78; Bradford Street pump and tunnel plant, $337; Culver wells, $881; Orange Grove Avenue reservoir, $184; office furniture, $925; street improvements, $5,478, and other items, bringing the total to $38,647.

TRANSPORTATION.

Bisbee, Ariz.—It is reported that the Warren-Bisbee electric railway system will be connected with Douglas. For this work only eight miles of grading would be required.

San Diego, Cal.—The City Council has referred to the street committee the petition of the San Diego Electric Railway Company for a franchise to build an extension to Spreckels Heights.

San Francisco, Cal.—At the adjourned meeting of the Presidio & Ferries Railroad Company, held here this week, the old officers of the company were re-elected. No change in the present policy of the company was decided on.

San Francisco, Cal.—According to reports in the local papers, plans for an electric railroad between San Francisco and San Jose, to be known as the Peninsular Railroad, have been completed by the Southern Pacific. It is believed the road will be in operation some time this year.

San Francisco, Cal.—The Public Utilities Committee of the Board of Supervisors has decided to recommend that the temporary permit for the United Railroads to operate electric cars on the outer tracks on lower Market Street, shall be extended thirty days from February 11th.

Stockton, Cal.—Rumors continue to circulate here as regards the Central California Traction Company, one of the companies financed by the California Safe Deposit & Trust Company. It is asserted that the company will change hands before the end of the present month, and that the new ownership will bring it under the control of the Harriman railroad interests.

Redlands, Cal.—The Redlands Central, the new electric railway system here, will, it is announced, begin securing rights of way for the proposed line out Brookside Avenue to Riverside. C. H. Chestnut and C. H. Dunn, promoters of the Redlands & Yucaipa line to connect this city with the summer resort of Oak Glen, say that the road will be constructed by next summer.

Vallejo, Cal.—C. A. Nelson, a contractor who has been doing work for the Western Pacific Railroad Company, was in Vallejo a few days ago, in connection with the Vallejo & Northern. He stated that the Western Pacific interests are behind the Vallejo & Northern, and that a portion of the $50,000,000 loan obtained by the former would be used for the construction of the latter from Vallejo to Sacramento, at which city a union depot for the two roads would be built. Work on the Vallejo line will be resumed, according to Mr. Nelson, on May 1st.

FINANCIAL.

San Francisco, Cal.—The City Attorney has advised the Board of Supervisors that the charges fixed for water cannot be varied for various parts of the city, nor for various companies. The question came up in the matter of fixing the rates for the County Line Water Company.

Pasadena, Cal.—Stockholders of the Lake Vineyard Land & Water Company have been notified of an election to be held on January 24th, for the purpose of voting on a proposition to dispose of the company's property to the municipality for a consideration of $382,500 plus $88,000, the cost of improvements.

Oakland, Cal.—It is announced from the District Attorney's office that a motion will soon be made in the Federal Court to dismiss the injunction restraining the county of Alameda from selling the property of the Contra Costa Water Company for non-payment of taxes. Taxes to the amount of $104,000 are involved in the suit.

San Francisco, Cal.—Attorney Daniel O'Connell has again filed with the Board of Supervisors, a copy of his petition, in which he requests the Board to rescind the franchises granted the Home Telephone Company and the overhead trolley privilege of the United Railroads. The petitioner asks for a hearing before the Board.

Los Angeles, Cal.—According to a report filed here by the secretary of the Pacific Light & Power Company, the company earned, during 1907, $413,142 in profits. The earnings from light in the city were $463,882, and from power in the city, $525,894. The total earnings being $1,281,055, there is left $291,277 as the profits on the sale of light and power outside of the city. The total expenditures made during the year, both inside and outside of the city, were $867,912.

OIL.

Bakersfield, Cal.—It is asserted here that W. H. Porter, president of the Associated Oil Company, has agreed to pay the independent producers of the Kern and Coalinga districts, sixty cents per barrel for their product. It is held that the agreement at this figure will call for 10,000 barrels daily for two years.

Salt Lake City, Utah.—The Star & Crescent Oil Company, operating in the Virgin River field, has finished its second well, and reports having secured oil at the first producing strata. Oil was tapped in the first well at a depth of 590 feet, and the same strata was cut in the second well, about 1,000 feet west of the first one, at a depth of 615 feet.

Los Angeles, Cal.—An agreement has been reached between the Associated Oil Company and the Graciosa Oil Company, by the terms of which the former has taken over, for the time being at least, the 20,000,000-barrel Japanese contract. This will relieve the Graciosa Company from the necessity of going into the open market to get oil to fill its contract. The demands made on the Graciosa fields for local refining purposes have cut deeply into the supply available for export.

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., FEBRUARY 22, 1908 No. 8

ELECTRIFICATION OF RAILWAYS.*

By DR. GISBERT KAPP.

Before beginning to write out these lectures I did what specialists generally do—namely, looked in the "Encyclopaedia Britannica" in the hope of finding a comprehensive article about the early history of the subject which might be utilized. In this I was, however, disappointed; the "Britannica" mentions only one case of the early history of electric propulsion on a railway, and gives no details. It says merely that a certain R. Davidson had constructed an electric locomotive which weighed five tons and was run at a speed of four miles per hour over the Edinburgh-Glasgow Railway. The date given is September, 1842. As in those days the trolley was unknown, we must conclude that this locomotive, like the well-known boat of Prof. Jacoby, was propelled by current derived from primary batteries.

The first electric railway in the modern sense of the term (that is, with current supplied to the motor by a conductor from a source fixed outside the vehicle), was undoubtedly that shown at an exhibition in Berlin in 1879 by Werner von Siemens. Although more like an interesting toy in appearance, it had most of the characteristics of later work. A 3-horsepower motor was mounted on wheels and connected by spur gear with the axles. This was the locomotive, and it drew a few small carriages with seating accommodation for a few passengers after it. The speed

SINGLE PHASE-A. C. ELECTRIC ROAD AT SPOKANE, WASH.

*Lecture delivered before the Royal Institution of Great Britain.

was four miles per hour. The current had a pressure of 150 volts, and was brought to the motor by a "third rail" laid between the track rails, and a sliding contact was used as a connecting link between the conductor and the motor. The return current was taken back to the generating dynamo by the track rails. We have here some of the essential elements of the modern electric railway, and it is rather surprising to find that Werner Siemens in his next application of electricity to the propulsion of a vehicle on rails abandoned the principle of the "third rail," and used the track rails both as lead and return conductors. This was in the electric tram-line at Lichterfelde, near Berlin, joining the railway station with the military academy. The voltage was 180 volts, and the maximum speed attained 22 miles per hour. The gauge was 1m., and the car weighed, with its full complement of 26 persons, 4.8 tons. Very soon after—namely, in 1883—the well-known Portrush-Bushmills line in Ireland was opened. This is a line with 3 ft. gauge six miles long, and containing gradients up to 28 per 1,000. Here the third rail (19 lb. per yard) is again used with return through track rails, and the speed on the level is 12 miles per hour. In America the first electric line was opened for traffic one year later, and from 1884 onwards there has been a steady development of electric traction, first for tramways and then for main lines of railway. I do not propose to sketch the history of this development in detail, as that would leave me no time for the treatment of the technical side, but I may draw attention to one landmark in this history—namely, the work done by a group of technical and financial men who formed a committee for the "study of high speed electric railways." By the close of the last century there had already been electrified various main lines, both in Europe and America, but the speeds were moderate, and the experience thus far obtained was hardly of the nature to enable engineers to predict what would happen if electrification were attempted at speeds equalling or exceeding the fastest runs of steam locomotives. It was to collect data on the various points affected by speed that the famous Zossen trials were made with two cars built by rival firms. With an expenditure of 1,000 horsepower the car attained a speed of 125 miles per hour. It was fitted with four three-phase motors of nominally 250 horsepower each, but on starting the motors could be heavily overloaded, the total intake of power by the car amounting for short periods to as much as 3,000 horsepower. The car weighed 94.5 tons. The working pressure was 10,000 volts, three-phase current supplied by three lines erected vertically above each other by the side of the track. This method of arranging the trolley wires requires so much head room as to render the system inapplicable to existing lines on account of bridges and tunnels. The value of the Zossen trials lies, therefore, not in proving that high-speed electric traction is possible with the particular arrangement chosen, but in providing data on which to calculate the power required at high speeds and in the demonstration that it is possible to take off as much as 1,000 horsepower at so high a speed as 125 miles per hour. It should be noted that before the highest speed could be attempted the permanent way had to be strengthened.

Advantages of Electrification.

It might be asked, Why should we electrify main lines? The answer is that we want to travel more frequently, more quickly, more safely, in greater comfort, and, if possible, more cheaply than by steam. As regards greater comfort and more frequent opportunity of travel, the superiority of electric traction has been demonstrated by the lines already electrified. As regards greater economy, the proof is as yet doubtful, but it would obviously be premature to deny greater economy merely on the ground that it has not yet been attained in the few isolated—and I might say, tentative—installations started up to the present. When the electric light was first introduced into our homes we had to pay 8d. a unit, but now, with its more general application, the average price has come down to about half that sum. So it will be with electric travel. A few dozen miles electrified here and there can hardly be expected to result in great economies, but let the whole system be electrified and any inherent advantage in an economical sense must make itself felt. The economy will naturally be greatest in the countries where coal is dearest, and it is for this reason that we see the Swedish, Italian, and Swiss Governments considering the introduction of electric working on a large scale.

The increase in traffic capacity, and especially the ability of the electric locomotive to handle heavier trains at higher speed, is due to the circumstance that, unlike the steam locomotive, it has not to carry the part that generates the power with it, but only the part that utilizes the power. In a steam locomotive the power is limited by the capacity of the boiler to generate steam. There is no such limitation in the electric locomotive, for the boiler (in the case that water power is not used) may be of any required size; there may be any number of boilers, and they may be arranged to burn any kind of fuel. There is no limitation to the power generated, but only to the power the motors on the locomotive can take up. Thus with equal total weight the capacity for dealing with heavy traffic is far greater in the case of the electric locomotive than in that of the steam locomotive. In this comparison I do not only mean drawbar pull, but the sustained effort of a strong pull exerted at high speed—in short, the horsepower. A modern electric express locomotive will develop about 30 horsepower for every ton of its own weight, and if built for slow passenger or fast goods service the power is about 22 horsepower, whilst even for slow goods service on heavy grades the power developed per ton of its own weight is still 10 horsepower to 12 horsepower. These figures are based on the generally accepted rating of a temperature rise of 75 deg. C. after one hour's run. For shorter runs the power will, of course, exceed the limits here given.

Another advantage of electric driving is the ability of exerting a greater drawbar pull at starting and on heavy grades, not only when by reason of motor coaches the adhesive weight is increased, but even in the case of locomotive traction for the same adhesive weight. In a steam locomotive the crank effort is not uniform. The skidding point is determined by its maximum, and the drawbar pull by its mean value. In the electric locomotive the crank effort is uniform, and it will, therefore, with the same adhesive weight and the same safe margin against skidding, have a 30 to 40 per cent greater drawbar pull than the steam locomotive. There is also greater safety against toppling over when going round curves. The modern steam locomotive with its enormous boiler has a high center of gravity, in some cases 5 ft. to 6 ft. above rail level; the center of gravity of an electric locomotive is only 3 ft. 6 in. to 4 ft. above rail level. Owing to the absence of reciprocating masses, the working is smoother and the wear on rails less; and, finally, as more of the total weight may be utilized for adhesion, and as the adhesive weight itself

is more effective, the traffic capacity of a given line can by electrification be increased, without those alterations in the permanent way which would be necessary if the same increase of traffic capacity were attempted by the use of heavier steam locomotives.

Then there is the question of economy in fuel and labor. By the latter I do not mean the labor actually required in driving a train. Although a fireman is not required, it would not be prudent to have only one man on the footplate on long express runs, although on short-stop runs this is perfectly safe. The saving of labor will come in consequence of the simplified service generally. There are no trips to the round house for cleaning tubes, and the labor in taking up brasses and generally keeping the gear in order will be much less than with the highly complicated mechanism of a steam locomotive. The ability to run in either direction makes the turntable superfluous, whilst multiple control applied to motor coaches at both ends of the train greatly simplifies the make-up of trains. As regards the fuel consumption whilst the train is actually running, there is probably no other economy than can be obtained by the possibility of using a cheaper kind of fuel in the fixed boilers, since the better efficiency of fixed boilers and engines is offset by the losses in transmission and conversion; but we must remember that a locomotive is much longer under steam than in actual service, and that during the time it stands waiting or makes trips necessary in putting trains together (what railwaymen call shifting) fuel is also consumed. The electric locomotive consumes no fuel at the power house except when actually at work.

All these are undoubted advantages, but what are the objections to electric propulsion. There can be no question that the electrical equipment of a train is as reliable as any mechanical apparatus can be, perhaps more so, because it is easy to fit safety appliances which will prevent overloading any part. Even under such trying conditions as the Simplon Tunnel, with its moisture and heat, means have been found of rendering electric working perfectly reliable. If electric traction has a weak part, it is certainly not in the train itself, but in the link between power house and train —that is to say, in the conductor with its sliding contact. That this weakness is not a serious matter is shown by the fact that many hundreds of miles of electrified main line are now in successful operation, but still there are difficulties, and it is interesting to briefly glance at them and at the means applied to overcome them. Of the two systems—viz., a third rail on the ground and by overhead conductor —each brings its own difficulties. The third rail is an obstruction. It may become a very complicated affair where many roads meet and cross. It may be a source of danger to persons walking or working on the line, and it may fail to act if its working surface is covered with ice. The overhead conductor has the advantage of leaving the permanent way perfectly free from encumbrance, and there is less difficulty at points and crossings, but it may obstruct the view of signals. That steam locomotives are sometimes also offenders in this respect was shown by the terminus of the New York Central Railway before that line was electrified. Here smoke and steam render the signals invisible, and as the obstructing body is continually shifting there is no remedy. A network of overhead wires may also obstruct the view, but this kind of obstruction does not change its position, and it is, therefore, possible to so place the signals that they are permanently visible. The single-phase line erected by the Westinghouse Company and a part of the three-phase line leading to the Simplon Tunnel shows this. In both cases the signals are perfectly visible.

In most of the third-rail equipment used at present the working face of the conductor is on the top. This has certain disadvantages. The lower edge is only about 4 inches above the sleepers, so that the danger of earthing from accumulation of wet snow and ashes or from even a slight flooding of the line is present; it is difficult to guard the conductor from contact without at the same time interfering with the contact surface, and the latter cannot be completely protected from snow and ice. To overcome these defects, Messrs. Sprague and Wilgus have introduced a type of third rail with "under-running contact shoe." The lower edge of the third rail, which is also the working face, is 9 inches above the sleeper and nearly 3 inches above the top of rail. The exposed part is sheathed with a fibre trough, leaving only the underside free for the contact, and although sleet may accumulate on the top and side of the rail it does not adhere to the contact face. On the New York Central system 285 miles of track are now being equipped with the Sprague-Wilgus third rail, and some other American lines have also adopted it.

In overhead construction for high speeds care must be taken to keep the conductor as straight as possible, as any sharp bends will cause the contact piece to jump and by drawing an arc to damage the wire. This was the reason why in the Zossen experimental line a side contact was provided. It was thought that with such an arrangement the sag of the wire could not affect the relative position of wire and contact piece, and this reasoning has proved perfectly correct. As, however, the head room necessary for the Zossen arrangement renders its adoption on existing lines impossible, another solution had to be found. This is the suspension by catenary. The catenary itself may have any sag required to render the system almost independent of temperature variation, and the suspension of the contact wire is effected by hangers of varying length, so that all the suspending points are exactly on the same level. Since the hangers can be placed fairly close to each other (three to ten yards), the sag of the contact wire can be made imperceptible. There is the further advantage that in the event of the contact wire breaking it will dangle free and not reach the ground. This is shown by the arrangements of the "single catenary system" used by the General Electric Company, and the double "catenary system" used by the Westinghouse Company and on the Swedish State Railways. On the latter the trolley wire is sub-divided into sections, one end of each section being anchored and the other attached to blocks and falls and a weight, which puts a definite tension on the wire whatever the change of length may be. The suspending arms are, of course, hinged to allow for automatic adjustment. Messrs. Siemens-Schuckertwerke have carried the catenary system still a step further by arranging two catenaries one above the other. The uppermost has long spans, and the lower is attached to it at frequent intervals by adjustable straps, the adjustment being possible in a vertical direction by altering the length of the strap and in a horizontal direction by shifting the clamp on the trolley wire. Stiffness at right angles to the axis of the trolley wire is obtained by horizontal pull-off wires. It should be noted that in all these systems the catenaries and all wires attached to them are insulated, so that the trolley wire is doubly, and in some cases trebly, insulated from earth.

To be continued.

REHABILITATION OF SAN FRANCISCO'S STREET RAILWAYS.

By Arthur H. Halloran.

(Concluded.)

Lower Market Street had never been brought up to the official grade by the city, and as a consequence, before the fire, the sidewalks of all the new buildings were laid 4½ feet above the street level. Repairing the fire's damage offered an unequalled opportunity to remedy this, and at the same time lay sewers and conduits. Advantage was taken of this chance by the Home Telephone Company, the City Electric Company, the Postal Telegraph Company, the Department of Electricity, and the United Railroads to install duct not but give a most unpleasant and unfavorable impression to visitors, especially if they had to pick their way through the resulting debris during the needless strikes that tied up the railroad lines for a little while during this period. A broad expanse of smooth asphalt now completely covers all this travail which will soon become but a memory.

Originally, two cable tracks, flanked on either side by the Sutter Street horse-car lines, handled all the street railway traffic of San Francisco's main east and west artery. At the Ferry terminus a turn-table reversed the incoming cars, and placed them on the outgoing track, or on one of the dead tracks laid for idle or mail cars, or to get one ahead of another. As a result, during the rush hours there was necessarily great congestion. Immediately after the

SAN FRANCISCO FERRY LOOP.

lines. The municipality let contracts to build two lines of sewers, one on either side of the street, this work naturally having precedence over all others. At the same time the Spring Valley Water Company was repairing its water mains, the San Francisco Gas & Electric Company was similarly engaged on its gas mains and electric distribution system, and the Mutual Electric Company was repairing its conduits. New culverts were also put in by the city, and in addition, new buildings were being erected on Market and side streets. This part of the city is all made ground, and immense pile drivers were at work on all sides driving piles for suitable foundations. Meanwhile the United Railroads not only had to install new electric tracks, replacing the old cable road-bed, but also had to maintain continuous service over its lines. The resulting chaos rendered work difficult, in the blinding dust or deep mud that prevailed respectively during the summer and winter of 1907, while this work was carried to completion. Such confusion could fire cross-overs were put in at the terminal, and the electric cars were thus run from the "down" south track on to the "out" north track. As this was entirely inadequate, in October, 1906, a loop was laid in front of the Ferry Building, later supplemented by an inner loop recently completed. The straight tracks in the center, now used for observation car storage, will be removed and a spur track will be run for this purpose to connect with the Mission and Folsom Street tracks, which come in at East St.

While the city was putting in its north sewer between Sansome Street and the Ferry, a temporary track was laid on the south side of Market Street and connected with the south loop, and the south cable track connected with the north loop, leaving the north cable track dead. When the north sewer was completed, work was started on the south. Consequently, the temporary south track was torn up and placed on the north side of the street, being connected with the north loop, the north cable track being similarly joined

to the south loop, leaving the south cable track dead.

When the sewers were finished, the north track was constructed on the new grade on the site of the Sutter Street horse-car tracks, likewise for the south track. In the meantime the cars were run on the old center cable tracks, by this time a trough, from one to four feet deep. With permanent tracks completed on either side, and a 60-day permit to erect overhead wires granted for construction purposes, the company was at liberty to tear out the old cable road-bed and build the new electric tracks in the center.

Below Davis Street the yokes were left intact, being covered with bricks and other debris after the slot rails, main rails and paving blocks had been removed. Red rock as ballast was placed to a depth of eight inches on top of this debris filling, being thoroughly rolled before the ties

MARKET AND SPEAR STS. NOVEMBER 20, 1907.

were put in position.

This red rock was the same previously described in connection with other work. As already noted, it had first been quarried and loaded by hand, put in connection with the large quantities necessary for this work, an electric shovel, as shown in one of the illustrations, was installed. This loaded a flat car with sixteen yards of rock in eleven minutes, breaking down most of its own rock, which was comparatively soft. The scoop has a capacity of three-quarter yards, and the shovel was constructed in the company's shops, using the derrick car as a basis. Lands End is five miles from lower Market Street, requiring a round trip of ten miles. In ten hours' time four cars, each taking sixteen yards at a trip, furnished 500 cubic yards of rock.

West of Davis Street, where the old grade was not so low, the tops of the yokes were cut off here and there where they interfered with placing the rails. The ties were laid between the yoke-uprights, which, with the concrete stringers used in all this work (previously described), gave practically a reinforced concrete construction that dynamite alone would remove. Grooved 9-inch rails, 141 lbs. to the yard, were used throughout, being tied and braced as already described. The usual form of basalt toothing and of asphalt paving completed the job. The four standard gauge tracks were laid on 12-foot centers, and paved two feet outside of either rail, giving a total width of 45 feet between Sansome Street and the Ferry. The two inner tracks were completed in twenty-five days working time. Incidentally the paving was finished one month before the city work was done. Its detail is better illustrated by the accompanying views than can be done by the writer's words.

The inner loop was put in when the two outer tracks were completed. As shown in the photographs and diagrams, this gives a double loop system as far out as Sutter and Sansome. Here it is that the main switching is done. Already plans have been made to put in a tower with compressed-air switch control at this point, although now the switching is done by hand. The Sutter, Haight, Eddy and Hayes Street cars take the outer loop, and the Castro, Valencia and McAllister, the inner, each line turning off from Market Street further out. Near the terminus it is

MARKET AND SPEAR STS. DECEMBER 13, 1907.

provided with five cross-overs with lever switches, three on Market at Steuart St., and two at the neck of the loop, so that in emergency any car can be run onto any track. The sharpest curves have a radius of 42 feet 7½ inches, and with the tangents give a roughly elliptical area about 175 feet wide and 204 feet long. This is paved inside, one-half with basalt blocks on concrete, the other with asphalt.

The work thus far described practically concludes all electric construction completed by the United Railroads to date. East Street is being raised to grade, and the seven tracks handling the Mission and Folsom lines will be reduced to four. Market Street between Sansome and Twelfth is of the old construction, and must be rebuilt. In all, there are 220 miles of electric road in operation.

The cable roads have been replaced by electric wherever the grade was not prohibitive. It is of interest to note that there is probably no city in the world where electric cars are regularly operated over such steep hills as in San Francisco. Haight Street has grades of from 11 to 12 per cent, as has also Masonic Avenue. On Devisadero and on Fillmore there are grades of 14 per cent, while Sutter has one of 13.3 per cent. Two blocks on Fillmore have 24 and 25½ per cent respectively, but are operated with auxiliary cable and counter poise. On Twenty-fourth Street, one of the standard cars has recently been replaced by a smaller one on its 16 per cent grade.

But in the cable system of the Powell and Mason, Sacramento and Clay, and Washington and Jackson lines, the hills are so numerous and the grades so great, reaching 19.4 and even 19.7 per cent, that electricity is not feasible. Consequently, the power plant at Washington and Mason Streets has been rehabilitated, as shown in one of the pictures, and cable cars are now running on Jackson and Washington between Steiner and Powell, and thence to Market on Powell Street, which is in operation for its entire length, also on Powell and Mason between Market and Bay Streets. The Sacramento and Clay Street lines will

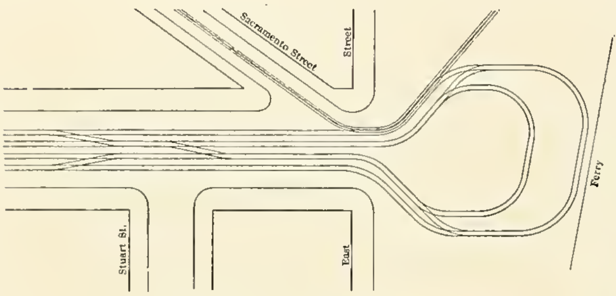


DIAGRAM OF FERRY LOOP.

soon be finished between Fillmore and the Ferries, all these streets being equipped with electric trolley west of Fillmore.

At Sacramento and Market Streets, the old "death curve," formerly passing within five feet of the curb, has been obviated by extending the cable track to meet the loop, and running the two together for a short distance, the cable branching off and completing the curve on East Street to Washington. This gives a distance of 17½ feet from the inner rail to the curb, as shown in the photographs and diagram. This is a pull curve, pulleys being placed between each yoke and allowing the cars to stop and start from any point, as the cable is always gripped. The cable track is of 3½ feet gauge, and is joined to the standard gauge electric so that but one crossing of the

TURK AND FILLMORE ST. SUB-STATION.

rails is necessary, and the short rail is not broken. The cars will run down Clay and out Sacramento, so as to run in the same direction as the electric cars on a part of the loop, a reversal of the former direction. This required that the Sacramento tracks between Hyde and Larkin Streets be shifted by means of hydraulic jacks, and another pull curve be put in at Larkin and Clay, and a full curve and crossing at Sacramento and Larkin.

The Castro Street line was all electrified excepting the 18 per cent grade on the Castro hill. This is surmounted by cable cars operated by a motor driven cable, operating between 18th and 26th Avenues.

The standard type of electric passenger cars are shown in several of the pictures, the United Railroads operating 600 in all. Their length over all is 45 feet 4 inches; width, 9 feet 3 inches, and height, 12 feet. They weigh from 28 to 29 tons, and are driven by four 50-horsepower General Electric direct current motors, with air brakes. They have a seating capacity of forty-four, with seats running lengthwise in the smoking compartment, and double reversible rattan seats and center aisle in the other. They can round a curve of 40 feet radius. They were built by the St. Louis Car Company, with Brill trucks, having 5-inch axle and 33-inch cast chilled wheels. In addition, the company has 47 repair, freight, derrick and other cars.

Temporary shops have been built at San Jose and Ocean Avenues, on the site originally bought for large shops capable of handling all equipment, and adequate for building the cars. A new car house is being built at 13th Avenue and H Street, and Fulton Street is being extended west

ELECTRIC SHOVEL.

along the north boundary of Golden Gate Park. The total cost of the reconstruction and rebuilding to date is estimated to be over eight million dollars.

The United Railroads generates its own power at the Bryant Street and at the North Beach power houses, the former furnishing 3,200 kilowatts and the latter 4,800. It buys 6,000 kilowatts from the California Gas & Electric Corporation, which is supplied to the Bryant Street power house, and 4,000 kilowatts from the City Electric Company, transmitted from their North Beach 60-cycle plant to the frequency changer in the United Railroad's plant, where it is changed to 25 cycle. The equipment of the Bryant Street and the North Beach power houses has already been described in this journal, as have also the sub-stations at Turk and Fillmore, Geneva Avenue and Millbrae.*

The Turk and Fillmore sub-station has had 31 feet 6 inches added to its east end, and has been repaired, as shown in the accompanying picture, giving total length of 140 feet 6 inches, and a width of 45 feet. Two 1,500-kilowatt Westinghouse rotary converters have been installed, together with transformers and switchboards, supplementing the six 750 General Electric machines already installed. The Millbrae sub-station has been patched up, and is operating satisfactorily. The same is true of the San Jose and

*"Journal of Electricity, Power and Gas," July 14, 1906.

Geneva Avenue station. Its equipment is to be increased by another 750-kilowatt converter, giving a total capacity of 2,300 kilowatts.

The 4,000-kilowatt frequency changer installed at the North Beach power plant by the United Railroads adds greatly to its former capacity of 4,800 kilowatts, which was repaired and put in operation soon after the fire. Plans have been drawn for a 5,000-kilowatt steam turbine installation to be added to this equipment at once. This will

WASHINGTON AND MASON ST. CABLE POWER HOUSE.

undoubtedly show better efficiency than the marine type reciprocating engines of the original installation.

The writer wishes to acknowledge his indebtedness to the various officials of the United Railroads for the information courteously furnished. The construction work is being carried on under the general supervision of General Manager Charles N. Black, and under the immediate direction of B. Peyton Legare, engineer of maintenance of way and construction for the United Railroads. The photographs were

CALIFORNIA AND POWELL CABLE CROSSING.

taken by J. H. Mentz, official photographer.

The history of the other street railway companies is similar to that already detailed, but on a much smaller scale. The power house of the Geary Street, Park and Ocean Railroad Company was beyond the fire zone, and cable cars were run as soon as permission to operate had been obtained, as the franchise had expired. Early in 1907 the California Street Cable Railway had rebuilt its burned power house, and had cars running on California, Hyde and Jones Streets. One of the pictures shows the cable crossing at California and Powell Streets.

The Union Street cable line has been electrified between Polk and Baker Streets to Harbor View and from the Ferry to Powell, buying its power from the United Railroads. The section between Powell and Larkin will be finished within a few months. One block with 19 per cent grade will require some safety device. Various girder rails, 85, 107 and 109 lbs., have been used in the reconstruction. The yokes were usually removed by hand, but in places the arms were cut so the rails could be laid to grade.

Thus concludes an important chapter in the industrial

SACRAMENTO AND MARKET CABLE CURVE.

history of San Francisco. It is characterized by a wonderful courage and a strong belief in the city's future, after the paralyzing effect of the world's greatest fire. We have avoided almost all reference to the various strikes and other hindrances occurring in this and all other of the city's great enterprises. They form another story, and are so recent and vivid as to require time from which to gain an unbiased perspective. These achievements in the face of great odds are a part of every engineer's life. To him they seem commonplace, by the world they have but scant recognition, to us it has been an unalloyed pleasure to record them.

CARE OF EXTRA TRAINMEN.

Santa Cruz, "The Atlantic City of the West," though a city of only about fifteen thousand inhabitants the year round, has between forty and fifty thousand people during a few months in the summer. Necessarily the Union Traction Company has to run a great many more cars in summer than in winter, thereby requiring a large force of conductors and motormen for the summer. S. W. Coleman, general manager of the company, who has had charge of the reconstruction of the Union Traction Company, one of John Martin's numerous electric enterprises, has adopted a novel scheme to hold his extra force of trainmen through the winter months, thereby insuring experienced and reliable men to run the extra cars in summer.

Most of the present extra trainmen worked all last summer, and when last fall came and the service was cut down, a section gang was formed consisting almost entirely of extra trainmen. At present this force of extra men is working with tamping bars, and in overalls, surfacing and lining the reconstructed track between Santa Cruz and Capitola. In this way the car men are given more or less steady work all the year round, and the company has a force of experienced trainmen equal to any emergency.

LABOR COST OF BUILDING A HIGH POWER TRANSMISSION LINE.*

A high power transmission line was to be run for about twenty miles. For all but 9,500 feet of this distance poles were up and being used for other purposes. For the distance named an entirely new line had to be built. This part of the line was along a public road. The poles and cross arms were delivered at one end of the line by railroad, so the average haul on material was about one mile. The poles were from thirty to thirty-three feet long, measuring from five to nine inches at the top and from twelve to eighteen inches at the butt.

The wages paid for a ten-hour day on the work were as follows:

Foreman	$3.00
Laborers	1.50
Linemen	2.50
Team two horses and driver	4.50

Hauling.—The poles were hauled on a two-horse wagon, one man assisting the driver in loading and unloading them. Naturally a large per cent of the cost of hauling was in taking the poles from the cars and unloading them from the wagon. The poles were of chestnut, fairly light, and eight to ten poles could be hauled at a trip. The cost of hauling the poles was:

Team	$22.50
Laborers	7.50
Total	$30.00

Digging Holes.—In digging the holes for the poles, one man worked on a hole. He used a digging bar, a shovel with extra long handle and a spoon with same length handle. The holes were dug five feet deep and were thirty inches in diameter at the top and about eighteen inches at the bottom, making an average diameter of two feet. From each hole was excavated 0.58 cubic yard. The material was a red, sandy clay, and the holes were all dry. There were seventy-four holes dug. The cost was:

Foreman	$17.25
Laborers	55.50
Total	$72.75

The cost per hole was as follows:

Foreman	$0.23
Men	0.75
Total	$0.98

The cost per cubic yard was as follows:

Foreman	$0.40
Men	1.30
Total	$1.70

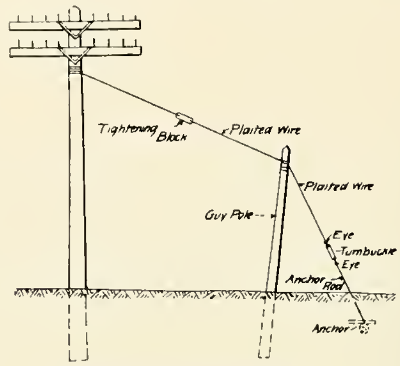
Raising Poles.—The pole raising was done by hand. A deadman and a jenny were used, these being manipulated by two men. The foreman or a linema.ı held a metal slide in the hole for the butt of the pole to slide against, keeping it from gouging ino the side of the hole. The rest of the crew used pikes to lift the top of the pole, and place it in the hole. The crew consisted of the foreman, one lineman and about seven men.

The method of operation was as follows: The pole was rolled to the hole by means of bars and cant hooks. The slide meantime was placed in the hole. Then the crew lifted the small end onto the jenny which held it until the deadman was put in place. With the pole resting on the deadman, the pikes were brought into play, and as the pole was lifted the deadman was moved up under the pole until the final lift came that sent the pole into the hole. Then it was turned and lined up, the lineman assisting the foreman in this work, after which the refilling of the hole was done.

*Engineering-Contracting.

A record of this work was kept in detail on a number of poles, from which it was found that the average time consumed in the work was as follows:

Getting ready to set pole, three minutes; raising pole, six



METHOD OF RAISING POLES.

minutes; lining pole, two minutes; filling and tamping earth in hole, one man shoveling and three tamping, ten minutes, several men standing by the pikes to steady the pikes; moving to the next hole, four minutes; total time, twenty-five minutes.

When everything is working well this average can be maintained, but a little time is occasionally lost due to unforeseen obstacles that prevent this speed. The cost of raising the poles was:

Foreman	$10.50
Laborers	37.50
Lineman	8.75
Total	$56.75

This, for the seventy-four poles, gives a cost per pole of the following:

Foreman	$0.14
Laborers	0.50
Lineman	0.12
Total	$0.76

Cross Arms.—Before raising the poles, and while the laborers were digging the holes, the linemen were at work dapping the poles to receive the cross arms. The cross arms used were eight-pin arms, two being placed on each pole. At all times in the line, double cross arms were used, that is, a cross arm was put on each side of the poles. This was the case for nine poles. For future needs the poles were dapped in three places. This made 240 daps necessary. The poles, as stated, were chestnut. The cost of dapping the poles was $22.62, making a cost per dap of 9.8 cents.

One lineman placed the cross arms, the team hauling them along as needed, and the driver acting as the lineman's "ground hog." The sketch shows how these arms were placed, and braced with two pieces of galvanized iron. In all, 166 cross arms were used. The cost of this work was:

Hauling with team	$21.37
Lineman	6.25
Total	$27.62

The high cost of this was due to the fact that the team was charged to this work for the entire time of placing the cross arms, as it waited at each pole while the arms were being put in place. The cost per cross arm was 17 cents.

One lineman and a helper placed the insulators. The cost of this was:

Lineman	$3.75
Helper	2.25
Total	$6.00

Only six insulators were put on a cross arm, thus making 12 to a pole, except at the turns, as the line was to carry 12 wires. In all 996 insulators were used, hence the cost per unit was 0.6 cents.

Guy Poles.—In building lines with a number of wires on them, it is necessary to guy all poles where there are turns in the line, and on long straight lines some of the poles must also be guyed. The sketch shows the method used in guying this line, and is one frequently used. The guy pole holes were dug of about the same dimensions as the holes for the line poles.

The cost was:

Foreman	$1.50
Laborers	6.75
Total	$8.25

The cost per hole was:

Foreman	$0.17
Laborers	0.75
Total	$0.92

The raising of the poles cost:

Foreman	$3.00
Laborers	9.00
Total	$12.00

This makes a cost per pole of $1.33. This is large, owing to the fact that the men lost considerable time moving from pole to pole and carrying their tools, also to the fact that each pole had to be cut and trimmed, as these guy poles were made from rejected line poles.

The method of placing the guy wires to the poles was as follows: The wire was fastened to each of the two poles, and then brought to the tightening block as shown in the sketch. With blocks and tackle fastened to the two poles, the poles were brought to a snug bearing and the wires were made fast around the tightening block, shown in the sketch. The wires go around the block in grooves made for the purpose at right angles to each other. While the linemen and their helpers are doing this work, the laborers are digging the anchor hole and placing the anchor rod. To this is fastened a turn buckle, and a wire is run from the guy pole to the turn buckle. The blocks and tackle are then fastened to a handy tree or stump, or, if necessary, to the anchor rod and the guy pole is pulled back, tightening the guy wire between the two poles, while the turn buckle is screwed up, thus making all the guy wires taut. At times, instead of making an anchor as shown, the anchor wire can be fastened to a convenient tree. Both kinds of anchors were used in this case. The cost of this work was:

Foreman	$1.50
Linemen	3.75
Laborers	3.75
Total	$9.00

This made a cost of $1.00 per pole, making a total cost per guy pole of $3.25.

About one-half of this line ran through the edge of woods or by shade trees. A few trees had to be cut down and a number trimmed; some tall bushes were also cut down. The foreman looked after this work part of one day when all his force was at work upon it, but for the most part linemen were in charge of several laborers doing this work. The cost of it was as follows:

Foreman	$ 2.25
Lineman	18.12
Men	13.13
Total	$33.50

Stringing the Wires.—As previously stated, 12 wires were strung on the poles. The wires were light weight. The team hauled the wire, and one horse was used in helping to string it, the other horse standing idle. In line work, a team is nearly always necessary, yet there are times that it may stand idle for hours, thus increasing the cost of that item to which it is charged. When there is nothing else for the wagon to do it is used to carry the tools along the line as the men work. In stringing the wire the horse pulled a rope fastened to two strands of wire at one time, thus running out two wires, and making six trips of the horse to string out the 12 wires. For this work 3 linemen were used, but in fastening the wires to the insulators only 2 linemen were used, and the wires were pulled tight by the helpers with blocks and tackle. The cost was:

Foreman	$ 18.00
Linemen	37.50
Laborers	27.00
Team	36.00
Total	$118.50

In all, 21.6 miles of wire were strung, and this made a cost of $16.50 per mile of wire.

Changing Poles.—At the ends of the line where connections were made with the old line of poles, some poles had to be changed to make them suitable for the new service. There were 3 of these at one end, and 1 at the other. The work consisted in taking down the old poles and putting in their place poles from 40 to 50 feet long. Cross-arms had to be put on the new poles, and the wires changed over to the new poles. It took a half day for the crew to do each pole, thus spending 2 days on the 4 poles. The cost of this was:

Foreman	$ 6.00
Lineman	2.50
Laborers	39.00
Team	9.00
Total	$56.50

This gave a cost per pole of $14.12. In line work the foreman is always a lineman, and in doing odd jobs this frequently keeps the cost down, as he will often do work that a lineman is called upon to do. As the lineman is the higher priced man he should be allowed to do only such work as the helper is not able to do.

Total Cost.—The total cost of the entire work was as follows:

Hauling	$ 30.00
Digging Holes	72.75
Raising Poles	56.75
Dapping Cross-Arms	22.62
Placing Cross-Arms and Insulators	33.62
Guy Poles	29.25
Trimming Trees and Bushes	33.50
Stringing and Fastening Wires	118.50
Changing Old Poles	56.50
Total	$453.49

There being 1.6 miles of line built, the cost per mile for each item was:

Hauling	$ 18.75
Digging Holes	45.47
Raising Poles	35.47
Dapping Cross-Arms	14.14
Placing Cross-Arms and Insulators	21.01
Guy Poles	18.28
Trimming Trees and Bushes	20.94
Stringing and Fastening Wires	74.06
Changing Old Poles	35.31
Total	$283.43

For the 74 new poles erected this makes a cost per pole for the completed line of $6.13.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Los Angeles Office Wm. J. Gracey 525 South Spring St.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX FEBRUARY 22, 1908 No. 8

EDITORIAL.

GAS RATES.

The intimate connection that exists between the subjects of public control of public utilities and that of municipal ownership is exemplified in the plea of the San Francisco Gas & Electric Company, before the Board of Supervisors of San Francisco, that the rate charged for gas be raised from eighty cents to one dollar per thousand feet. This company manufactures a petroleum-enriched water-gas at an actual present cost of 75½ cents per thousand cubic feet, exclusive of bond interest and sinking fund. During 1907, 2,528,767,400 cubic feet of gas gave gross receipts of $0.8166 per thousand, thus giving $155,431.14 to take care of the bond interest and sinking fund of $381,932, as well as pay dividends on an estimated value of $17,894,173.27, or an assessed value of $3,739,221, which, allowing the usual assessing percentage, represents $7,609,800, a feat apparently impossible of accomplishment, especially when the further item of depreciation is considered.

Rates are to be fixed for the years 1908-9, before the first of March, and in summarizing probable conditions, General Manager John A. Britton states that oil, representing one-third of the total cost of the gas, will advance July 1, 1908, 25 cents per barrel, making an added cost of 6¼ cents per thousand. Interest at 7 per cent and depreciation at 5 per cent add 34¼ cents to this, a total of $1.18.

In accordance with these figures which we quote from the argument presented to the Board of Supervisors, no public service corporation could long hold out from municipal ownership. The company has given permission to have its plants and books examined to verify its figures. If the findings of a commission appointed for this purpose are in accord with the figures indicated, equity can suggest but one answer to the question of increasing the rate. Our comment is superfluous.

STEAM ENGINE vs. PRODUCER-GAS ENGINE.

Conservation is no more important than correct utilization, nor is there any other saving factor as great. In this particular, how little has modern man progressed beyond the ancient Greek with his Prometheus-stolen fire brand for light and heat! Our best reciprocating steam engines use but five per cent of the total energy available, though by the use of superheated steam in the steam turbine, this has been somewhat increased. In the United States, coal is being used at the rate of over 400,000,000 tons per year, and over 126,000,000 barrels of petroleum are consumed annually. A halt may yet be called in this wastefulness.

In the fuel tests conducted by the United States Geological Survey, comparison was made of the relative economies of steam and gas power plants in the conversion of one pound of coal containing 12,500 British Thermal Units. The result is expressed tabularly:

	Steam Power		Gas Power	
	B.T.U.	Percent	B.T.U	Perc't
Losses in exhaust, friction, etc.	11,892	95.14	10,812	86.5
Converted into electric energy	608	4.86	1,688	13.5
	12,500	100.	12,500	100.

The results indicated fulfil the intention of showing the greater efficiency of a producer-gas engine as compared with a reciprocating steam engine. Many low-grade fuels which give poor results under steam boilers are satisfactory in the gas producer. Thus is opened up the industrial development of hitherto waste lands. The report further shows the reliability and cheap running of gas engines in experienced hands, and indicates the future centralization of power development. But how puny and insignificant will these efficiencies appear in the future, when Science has solved the problem of the rational utilization of low-grade fuels and of the burning of coal without smoke, by the substitution of some source of power beyond our ken.

REMOVAL NOTICES.

The Weidenthal-Gosliner Electric Works expects to be established at Mission and New Montgomery Streets, before the 1st of March.

The Armstrong-Kreling Machinery Co. has moved to 564 Howard Street, from 88 Second Street, San Francisco.

The Bryant Electric Company will have permanent quarters at Second and Mission Streets, San Francisco, moving from Oakland.

THE JOHN W. MACKAY JUNIOR FELLOWSHIPS.

In July, 1906, Mr. Clarence W. Mackay, jointly with his mother, Mrs. John W. Mackay, gave to the University of California one hundred thousand dollars, for the endowment of the John W. Mackay Junior Professorship of Electrical Engineering, with the proviso that such part of the income as the Regents of the University might determine, or the whole, was to be used for the salary of the incumbent of the chair, and that the residue of the income was to be devoted to the furtherance of research work in electrical engineering in the University.

In accordance with the terms of this endowment, the University of California has established two John W. Mackay Junior Fellowships in Electrical Engineering, of an annual value of six hundred dollars each. The tuition charges of the University are nominal. These fellowships are open to all properly qualified university graduates.

The object of the fellowships is not to facilitate ordinary engineering or scientific study, but to enable students who have completed a college course to do research work in electrical engineering, with a view to aiding the advance of the application of electricity to scientific and industrial purposes.

The place of residence of those holding the fellowships is to be at the University of California. Experimental or other work, however, may be carried on outside the laboratories of the University.

Opportunities for study and investigation in Electrical Engineering at the University of California are extensive, and the laboratories are well equipped for investigation and research work. The appointment to each fellowship shall be for one year, which appointment may, however, be renewed, at the discretion of the Graduate Council of the University.

Applications for these fellowships should be filed with the Recorder of the Faculties as early as March 15th, if possible.

For announcement of the courses and details of the work in Electrical Engineering and related subjects, and for application blanks, etc., address

THE RECORDER OF THE FACULTIES,
University of California, Berkeley, California.

TRADE CATALOGUES.

Monthly bulletin from the Ohio Brass Co., in addition to the usual notes, contains an account of Porcelain Insulator Testing and Third Rail Insulators for Industrial Railways.

Habirshaw Wire Co., of Yonkers, N. Y., sent an interesting reprint on "Rubber Insulation for Conductors," by Fred J. Hall, which tells some important, but little known, facts about rubber. It is well worth reading.

The General Electric Company, Schenectady, N. Y., describes an improved type of switch indicator known as the SI-104, in Bulletin No. 4563. Low pressure air compressors rated from .88 pound to 4 pounds per square inch and from capacities of 750 to 10,000 cubic feet of free air per minute are included in the line of centrifugal air compressors described in Bulletin No. 4564. These machines are similar to the well-known centrifugal pump in both appearance and operation, and consist essentially of a rotating impeller surrounded by a suitable casing with an intake opening at the center and a discharge opening at the circumference. In Bulletin No. 4544 is described the present design of switchboards for railway use. The following types are described: Generator panels including circuit breakers and equalizer switch panels, rotary converter panels, feeder panels for one circuit, feeder panels for two circuits with one ammeter per panel, and feeder panels for two circuits with two ammeters per panel. The various forms of apparatus used in connection with the panels, details of construction, etc., are described and illustrated, and complete tables giving catalogue numbers, capacities, etc., and dimension sketches, are given. A line of panels for small plant work of this character is described in Bulletin No. 4558.

PUBLICATIONS RECEIVED.

The U. S. Geological Survey sends a preliminary report by D. F. Randall on "The Burning of Coal Without Smoke in Boiler Plants," to which is attached a bibliography of the subject. The prevention of smoke is considered under the heads of feasibility, the principles of smokeless combustion, proper furnace equipment, difficulty in securing perfect combustion and indirect methods of smoke abatement.

In a recent bulletin issued by the U. S. Geological Survey is included an account by Mr. Robert H. Fernald of the present status of the producer-gas power plant in the United States. The greater portion of the contents is given up to a report of tests on producer gas made at the government test plant in St. Louis. His conclusion is that the situation seems to be favorable to the producer-gas plant, not only as to cost of installation, operation and maintenance, but also as to reliability.

The University of Wisconsin, of Madison, Wisconsin, sends some valuable bulletins from its engineering departments. No. 157 makes "A Comparison of the Effects or Frequency on the Light of Incandescent and Nernst Lamps," by F. W. Huels. No. 173 is "Investigations of Centrifugal Pumps," by C. B. Stewart, and No. 175 describes "Tests on Plain and Reinforced Concrete," by M. O. Withey.

"Mineral Resources of the United States for 1906" contains a statement of the production of mineral substances and the chief features of mining progress as collected by the U. S. Geological Survey. The book is divided into chapters, each of which treats of a separate industry. This volume maintains the high standard set for the past twenty-five years. It is sent free of charge to those interested.

"A Compilation of the Records of the Colorado Springs Lighting Controversy," by Henry Floy, published by "Illuminating Engineering Publishing Co.," 12 West Fortieth Street, New York City. The controversy between the City of Colorado Springs and the Pikes Peak Hydro-Electric Company has become memorable because it decided for the first time in a judicial way the meaning of the phrase "An arc light of standard 2,000 candlepower," the monetary damage accruing by the substitution of a 6.6 ampere series a. c. arc lamp for the above, and the financial damage resulting from the failure to maintain the substituted lamps at their normal operating conditions. Its complete history and details are here presented in compact form.

PERSONAL.

Tom C. Walsh, of the sales department of the Deveau Telephone Manufacturing Co., Brooklyn, N. Y., has been in San Francisco.

F. C. Finkle, consulting engineer, announces the removal of his office from the Edison Building to rooms 230-231 I. W. Hellman Building, Los Angeles, Cal.

R. S. Masson, chief engineer of the Electric Operating Construction Co., of 805 Union Trust Building, San Francisco, is at Prescott, Ariz., directing the work of the Arizona Power Company, a 7,500 horsepower water power development near Prescott, Ariz., the same having been recently financed. William P. Bonbright & Co., 24 Broad Street, New York, act as fiscal agents, and Viele, Blackwell & Buck are the consulting engineers.

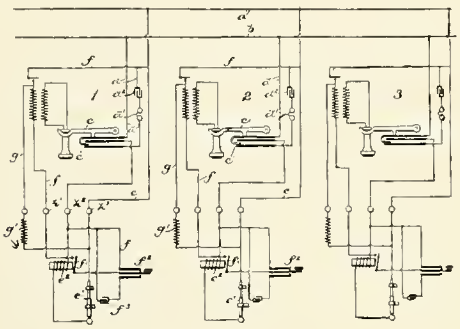
MEETING NOTICES.

A meeting of the New England section of the Illuminating Engineering Society was held in Boston, Mass., February 18th. L. W. Marsh read a paper on "Daylight Illumination."

PATENTS

LOCK-OUT DEVICE FOR PARTY-LINE TELEPHONES. 877,901. William M. Bruce, Jr., Springfield, Ohio, assignor to the American Automatic Telephone Company, Rochester, N. Y.

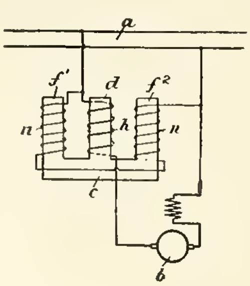
In a common battery line telephone system, an electromagnet at each subscriber's station means for bridging the same across the line, a normally open shunt around the said



electro-magnet including the subscriber's talking instruments, and a circuit closer in said shunt adapted to be operated by said relay, and a second shunt having permanent resistance around said talking instrument, the resistance of said second shunt and the relay being such as to utilize the current from the central energy, and prevent any other relay on the line from being operated.

MAGNET FOR ALTERNATING CURRENTS. 878,402. Christian Kramer, Frankfort-on-the-Main, Germany, assignor to Felton & Guilleaume Lahmeyerwerke Actien-Gesellschaft, Frankfort-on-the-Main, Germany.

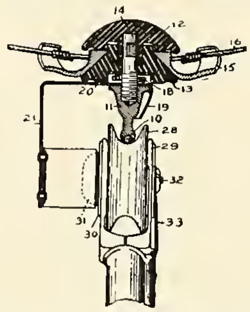
The combination with a source of single phase alternating current of an electro magnet comprising a core consisting of



three parallel pole pieces and a yoke connecting the same, and windings upon pole pieces, the winding upon one of pole pieces being connected in series across source with a substantially non-phase displacing, current-reducing means, the windings upon the other two pole pieces being connected in series across source.

OVERHEAD ELECTRIC CONTACT. 878,247. Thomas W. Small, Cleveland, Ohio, assignor to the Acme Automatic Street Indicating Company, Cleveland, Ohio.

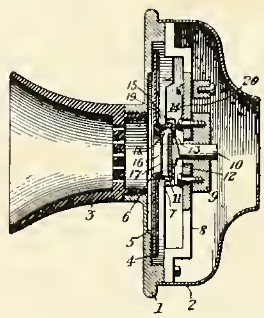
The combination with a trolley harp carrying at its side



a contact boss, and a contact making device presenting to such boss a plurality of flexible contacts arranged to bend in the direction in which the trolley is moving.

TELEPHONE-TRANSMITTER. 878,192. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio.

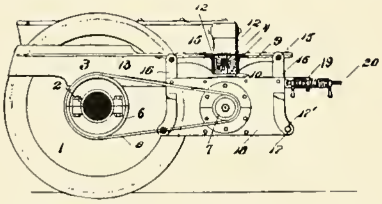
In a telephone transmitter, a cup containing granular material, a diaphragm having a stiffening rib or flange, and an



electrode carried by said cup and intraperipherally engaged by said flange, said electrode receiving motion transmitted directly from the diaphragm through said flange.

MEANS FOR MOUNTING AND DRIVING DYNAMOS FOR ELECTRIC-CAR LIGHTING. 878,305. Alexander McGary and John W. Jepson, New York, N. Y., assignors to Bliss Electric Car Lighting Company, Milwaukee, Wis.

Means for mounting a dynamo upon a car or other vehicle, comprising the end sill or beam of the car truck, a saddle plate



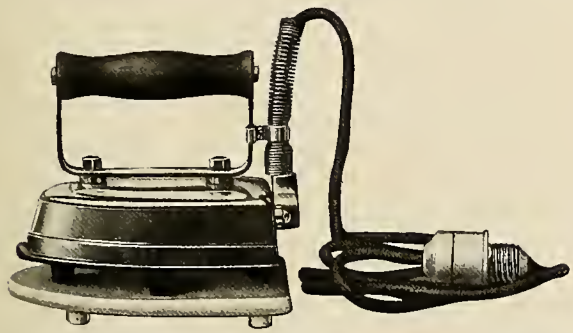
mounted upon said sill or beam and formed with a recess, the sides of which are adapted to embrace said beam, supporting links or members pivotally connected to said saddle plate on opposite sides of said plate, a dynamo machine carried by members, and driving connection between a car wheel or axle and the dynamo.

INDUSTRIAL

THE WESTINGHOUSE ELECTRICALLY HEATED SAD IRON.

There is perhaps no form of electrical apparatus that appeals to the housekeeper more strongly than does the electrically heated sad iron. Every household has its ironing and pressing to be done, and the older method of doing the work involves many unpleasant conditions, whether the work is done by a domestic or by a member of the family, from which the housekeeper is glad to be freed. Its universal adoption depends only upon the efficiency and durability of the iron. These two points are prominent in the iron that the Westinghouse Electric and Manufacturing Company is now placing on the market.

In form the Westinghouse electric iron differs only from an ordinary iron in its more symmetrical and attractive appearance, and in being provided with terminals and a flexible cord through which the current is transmitted. In operation it elevates ironing from drudgery to a comfortable and pleasant task. Its heating mechanism, which is entirely concealed, keeps the iron at the proper temperature at a minimum consumption



of current. It consists of a flat insulated resistance strip clamped by hydraulic pressure between two flat iron plates, forming a solid heating element of high thermal conductivity, and having a large heat storage capacity.

The design of the element is such that the heat is evenly distributed over the entire bottom of the iron, the edges and point being practically the same temperature as the middle of the bottom. A non-conducting element is used between the top of the iron and the heating unit. This construction results in the top of the iron being cooler than its face. The heating unit is hermetically sealed in its insulation, and cannot, therefore, deteriorate any faster than the iron, as it is not subject to the oxidizing effects caused by contact with air.

The iron is extremely simple, and there is absolutely nothing to get out of order or to require renewal. Irons which have been in use continually for the past six years, without costing a cent for repairs, are in as good condition today as ever. In fact, the electrical construction is so simple and durable that there is no reason why it should not last as long as the iron itself.

The terminals are protected by a solid metal guard, and the cord leading from them is securely anchored by a clamp on the handle of the iron. A wire spring which surrounds the cord at this point, prevents any sharp bends. A separable plug is provided by which the iron can be connected to any convenient lamp socket without twisting. A small spring attached to the cord takes up all slack, and so keeps it from dragging on the clothes or getting in the way of the operator.

The polishing surface of the iron is of highly polished cast iron, found by experience to be the most satisfactory surface for the purpose. The upper portions of the iron have a burnished nickel plate surface. The handle is of ebonized wood, heat proof and unbreakable. A heat proof stand, upon which the iron should be set when not in use, is provided with every iron.

The irons are made to suit all commercial lighting circuits, and can be used on either alternating or direct current with equally satisfactory results.

TECHNICAL PUBLICITY ASSOCIATION.

R. F. Bieber, president of the 1900 Washer Company, and W. H. Ingersoll, advertising manager of the National Cigar Stands, made addresses at a well attended meeting of the Technical Publicity Association in New York on the evening of January 30th. The speakers held to the topic of the evening, "Mail Order Advertising," and those attending joined in a general discussion of the subject. Members present represented: A. Allan & Son, N. Y.; John A. Roehlings Sons Co., Trenton, N. J.; Yale & Towne Manufacturing Co., N. Y.; Lidgerwood Manufacturing Co., N. Y.; Sprague Electric Co., N. Y.; R. R. Almond Manufacturing Co., Brooklyn, N. Y.; General Electric Co., Schenectady, N. Y.; Crocker-Wheeler Company, Ampere, N. J.; American Locomotive Co., N. Y.; A. S. Cameron Steam Pump Works, N. Y.; American Brake, Shoe and Foundry Co., N. Y.; N. Y. Telephone Co., N. Y.; Westinghouse Co., of Pittsburg, Pa.; N. Y. Edison Co., N. Y.; J. G. White & Co., N. Y.; Chas. A. Schieren & Co., N. Y.; M. H. Treadwell Co., N. Y.; Jos. Dixon Crucible Co., Jersey City, N. J.; American Goetze Gasket and Packing Co., N. Y.

HYDRO ELECTRIC PLANT FOR TOKIO, JAPAN.

The first 60,000-volt hydro-electric plant in Japan has just been put into service with signal success after having passed the rigid inspection which is required by the Japanese Government of all electrical installations. Power is obtained by impounding the Ugigawa River, a narrow and swift but deep river, such as is often found in the mountainous portions of the Flowery Kingdom. The normal capacity of the main station is 18,000 kilowatts, and is furnished by six 3,000-kilowatt, 50-cycle, 6,600-volt water wheel driven alternators.

The generator voltage is stepped up to the line voltage of 60,000 volts through three banks of three each single phase water-cooled 2,000 kilowatt transformers, at which potential it is transmitted 25 miles to Waseda sub-station, just outside the city of Tokio. In this main sub-station water-cooled transformers of 1,800 kilowatts each step down the line voltage to 11,000 volts, at which potential it is transmitted underground through lead armored cables to eleven distributing sub-stations situated in various parts of the city.

In each of these smaller sub-stations oil-cooled transformers of 250-kilowatts capacity step the voltage down to 2000 volts, the line potential of the city circuits. The territory immediately surrounding the Waseda sub-station is also fed with low voltage current for light and power purposes.

The entire transformer, regulating and controlling equipment consisting of eighteen water-cooled and fifty-four oil-cooled transformers, eighty-one single phase induction feeder regulators and 149 switchboard panels was furnished by the General Electric Company, as was also the lead armored cable.

INCREASING USE OF ELECTRICAL APPLIANCES IN KOREA.

Consul-General Thomas Sammons, of Seoul, furnishes the following information concerning Korea as a market for electrical appliances, fans, and motors:

The Koreans, having discovered the service and comfort afforded by electrical power and lighting, are rapidly installing small motors in their shops and lights in the homes at Seoul. The modern Korean palace has been lighted for some time by electricity, and of late commercial plants have been established at Chemulpo and Fusan, while two plants, under one management, supply light and power to Seoul, the capital.

The Seoul plant, which furnishes light for commercial purposes and power for electric tram lines, has recently been enlarged until its capacity is almost doubled, and further improvements are contemplated. This plant formerly furnished light from the tram-car current mains, but the result of the varying direct current, under this system, gave unsatisfactory lighting facilities. Therefore, a new and improved plant, furnishing an alternating current of 100 volts, 60 cycles, and 7,200 alternations, was installed.

Attracted by the improved quality of the light furnished by the new system, many Koreans are installing electric lights in their homes. The company controlling this plant has been rushed of late with orders for three and four light wiring. The company installs fixtures of a standard nature, charging a monthly rental for these in addition to the regular current charges. This company, therefore, is steadily importing and installing American fixtures. The current supplied in Seoul is steam generated by engines of a modern nature. Of late this company has been installing for the Koreans many small motors, capable of running rice mills and other light machinery. The electric motor is a great novelty to the Koreans, who seem greatly pleased with it, and quick to see its advantages. The Koreans are reported as well pleased with the results obtained from the use of the motors and electric lights, and, consequently, the company supplying this trade is on the market for many and various electrical fixtures.

It is believed that electrical fans will be used in Korea as soon as the natives able to purchase them become accustomed to the various uses of electricity. It was some time before the Koreans began to enjoy electric car rides, and it is also believed that they are only beginning to show their appreciation of modern electrical improvements.

The American-Korean Electric Company, of Seoul, intends to introduce fans extensively during next summer, and electric flatirons, warming pads, and other novelties will probably follow in due course. The steady market demand at present, however, is limited to motors and fixtures. On account of the power companies' method of installing fixtures and then renting them to the consumers, there are no stores in Korea carrying exclusive stocks of electrical fixtures and furnishings, as is the case in the United States. The power companies import the bulk of these supplies direct.

The Oriental Consolidated Mining Company, operating at Unsan, has recently installed a modern and complete turbine electrical generating plant, capable of operating their stamp-mill machinery and mine hoists. Water is carried from a reservoir, with 111,599,231 cubic feet of available water, through a flume to the power house. This company is using American electrical materials exclusively, and is at present enlarging the scope of its plant.

The electrical companies at Fusan and Chemulpo supply only current for electric lighting purposes and install appropriate fixtures, while the small plant supplying light to the imperial palace at Seoul operates but a few hundred lights. The Chemulpo company may be said to confine its material and supply accounts largely to German markets or German business connections.

The Korean duty on imports of this nature is 7 per cent, with no limit to the size of packages.

Shipments can be made to Kobe or Nagasaki, Japan, Kobe being preferable, thence to Chemulpo, the port of Seoul. Rates from Japan to Chemulpo, $3.98 gold per ton.

ANNUAL DINNER OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The annual dinner of the American Institute of Electrical Engineers will be held at the Waldorf-Astoria, Fifth Avenue and Thirty-fourth Street, New York City, on the evening of Wednesday, February 19, at 7 o'clock. Carrying out the idea established upon former occasions, the feature of the dinner this year will be the tribute rendered by the speakers to the relation of the electrical engineer with public-service corporations. The occasion will be designated as the "Public Service Dinner," and among the speakers who have promised responses to toasts are many men prominently identified with public-service utilities, either as members of commissions or operating heads of large utilities organizations. The price of the dinner will be $5, not including wine or cigars. As usual, ladies will be present. Guests will be seated at small tables accommodating eight persons. The dinner committee is composed of Robert T. Lozier, chairman; A. A. Gray, Frederick C. Bates and George H. Guy.

CONVENTION OF BRANCH MANAGERS OF THE H. W. JOHNS-MANVILLE CO.

In accordance with their usual custom, the H. W. Johns-Manville Co. held a convention of its branch managers, in New York, from January 29th to February 1st. The managers of the various branches of the company throughout the United States were present at the meeting, and a general discussion of the business affairs of the company took place. As a fitting wind-up of the convention, a banquet was given to the managers, at the Union League Club, on Friday evening, January 31st. The convention was pronounced a decided success by all present.

The General Electric Company is furnishing the entire electrical equipment for the Tajo mines, in the Rosario district of Mexico. The order includes a three-phase, 60-cycle, 2,300-volt revolving field generator of 150 kilowatts capacity, 9 oil-cooled, type H transformers, three 440-volt, form K, induction motors, of 15, 35 and 75 horsepower capacity, with starting compensators, 2-circuit feeder panel, complete lightning arrester equipment, and the necessary supplies of wire, insulators, etc.

"Sound Waves," published at Chicago, Ill., has been sold to the McGraw Publishing Company, of New York City, who will consolidate it with the "American Telephone Journal." The February issue will appear in the form of the consolidated paper.

The United States Civil Service Commission announces an examination on March 25, 1908, to secure eligibles to fill a vacancy in the position of draftsman, qualified in engineering construction and supervision of plumbing installation, at $6 per diem when actually employed, Immigration Service, Ellis Island, N. Y., and vacancies requiring similar qualifications as they may occur in any branch of the service.

The examination will consist of architectural engineering, plumbing work and installation, and training and experience.

NEWS NOTES

ILLUMINATION.

Long Beach, Cal.—The Long Beach Asbestos Company will sink a sixteen-inch well at once to a depth of 400 feet to develop a further gas supply.

Petaluma, Cal.—A committee has been appointed to look to the advisability of building a municipal gas plant and erecting a municipal rock crusher and to ascertain the cost.

Lakeport, Cal.—In the matter of the deal between the Lake County Electric Power Company and the owners of the Kelseyville gas wells for the purchase of their property, the purchase price had been agreed upon, but the time of payments had been left open and they failed to agree on this point. The company is going ahead with its work, and will procure its power from another source.

Guadalajara, Mexico.—A Mexican capitalist, who last year secured a concession from the government for establishment of a gas plant at Guadalajara, states that he will have a gas manufacturing plant in operation within a year. Oil will be the fuel. H. N. Sessions of Los Angeles has arrived to prepare the plans for the plant and mains. An effort will be made to secure oil from either the Mexican Petroleum Company or the Pearson interests.

San Francisco, Cal.—John A. Britton, president of the Pacific Gas & Electric Company, appeared before the Supervisors last week and asked that the Board fix new gas rates at $1 per thousand. Edward C. Jones, chief engineer of the gas company, produced a carefully prepared chart which dealt with the cost of making gas, its various processes, losses by leakage and cost of labor. He maintained that the company paid the highest wages in the world to gas-makers and worked them shorter hours than any other like corporation. According to Mr. Britton, the revenues derived from the sale of gas during the year just closed amounted to $2,291,672.39. The company's loss, he said, was something more than $250,000. Britton swore that the original cost of the gas plants was $16,809,639.88. During the recent calamity the company suffered a loss of $4,500,000, and recently it was forced to levy an assessment of $10 on each share of stock in order that current debts and losses might be met. Britton said that the outstanding capital of the corporation was $15,794,284.36; outstanding bonds, $8,800,000, and the net amount of floating debt $1,998,436.82.

TELEPHONE AND TELEGRAPH.

Merced, Cal.—Permission has been granted by the Board of Supervisors to the Hayes Company to erect a private telephone line from the Sheehy ranch to Athlone.

Bakersfield, Cal.—Permission has been granted to R. E. Galloway for the construction of a telephone line along the newly surveyed county road between McKittrick and Sunset.

Santa Rosa, Cal.—The Magnolia Telephone Company has been incorporated with a capital stock of $10,000. The directors are D. M. Winans, T. C. King, G. B. Robinson, Jas. W. George and Diedrich Rangers.

San Francisco, Cal.—The promoters of the Colusa County Telephone Company, consisting of residents of Glenn and Colusa Counties, have incorporated the Glenn County Telephone Company, and propose to install a system throughout the county of Glenn, similar to the one already installed in Colusa County.

San Francisco, Cal.—The Home Telephone Company plans to erect a six-story office building on the northwest corner of Grant Avenue and Harlan Place, and have made application through the Empire Construction Company, which is to build the structure, for the necessary permit. The estimated cost of the building is $175,000. The material used will be reinforced concrete.

WATERWORKS.

Roswell, New Mexico.—Prominent business men of Roswell are endorsing the proposed bond issue for putting in an additional water system and sewers, amounting in cost to $155,000.

Los Angeles, Cal.—Ten miles of water mains will be laid immediately at Monte Vista by Emil Firth, who has let the contract for the work. The waterworks and irrigation plant will cost $75,000.

Gilroy, Cal.—At the last meeting of the Common Council it was resolved that immediate steps should be taken to replace the water pipes on all the streets of Gilroy with larger and better pipe.

Redlands, Cal.—The Lugonia Park Water Company has completed arrangements for remodeling its water system, the work to be begun this spring. A cement lined reservoir will be constructed and new lines laid.

Lovelock, Nev.—The petition to the County Commissioners of the Mazuma Light & Power Company, asking permission to lay water mains in the town of Mazuma, has been granted. The work of laying the pipe will be commenced at once.

Selma, Cal.—E. B. Walthall, of the San Joaquin Light & Power Company, announced that his company had spent over $6,000 in improvements in Selma and expects to lay larger mains and new ones involving a larger expenditure in the next year.

Port Townsend, Wash.—McInnis & Harrington were the successful bidders on the construction of the Government water system at Seward, Alaska, at $69,518.36. Work consists of building a concrete reservoir, laying about fifteen miles of pipe, etc.

San Diego, Cal.—A petition for laying 600 feet of six-inch water mains in University east from Thirtieth and University, has been referred to the superintendent of the water department by the Board of Works. Another petition is pending contemplating a longer extension of the water main.

Riverside, Cal.—The Board of Directors of Corona will install a pumping plant to be operated by electricity at the corner of Ontario and Lemon Streets, the power to be supplied from the company's pumping station at Ethanac. A new line of 3600 feet will be laid, which calls for twelve-inch steel pipe. The pump will have a capacity for 100 inches.

Alameda, Cal.—The attention of the City Council has been called to the proposition of laying a water main on Webster Street to protect the warehouse district. The estimated cost is $5,000, and the water company has offered to pay half the cost. No definite action will be taken until President Titus of the water company returns from Seattle.

TRANSPORTATION.

Salt Lake City, Utah.—An ordinance has been passed granting an electric railroad franchise to the Emigrant Canyon Railway Company.

Oakland, Cal.—Guy C. Earl, vice-president of the Great Western Power Company, says that the Western Pacific is now perfecting its plans for the electrification of its system.

San Diego, Cal.—The City Council has adopted Concurrent Resolution 101, granting to the San Diego Electric Railway Company a franchise for a street railway along certain streets.

San Jose, Cal.—L. E. Hanchett, president and general manager of the San Jose & Santa Clara Railway Company, will open an office in San Francisco the first of next week. Mr. Hanchett will continue to reside in San Jose.

San Francisco, Cal.—Steps to procure 2,000 signatures to a petition to be presented to the Board of Supervisors to emphasize a plea for an electric trolley line in Pacific Avenue, have been taken by members of the Western Addition Improvement Club.

Reno, Nev.—Contractor Lund of this place states that he has been negotiating with a number of Reno capitalists in regard to a contract for the building of an electric railroad from Reno to Lake Tahoe and that he expects the contract to be signed up in a few days.

Perris, Cal.—The Simmen Automatic Railway Signal Company will remove its shops from Los Angeles to Perris within a few days. Extensive tests of the equipment are to be made by the Santa Fe Railroad, which will install the wires along its line and the Simmen Company will install and operate the system.

Redding, Cal.—George Springer, right-of-way man for the Northern Electric Company, is authority for the statement that the company has accepted the surveys for an extension of the line from Chico northward through Red Bluff and Redding to Kennett. The route has been fully decided upon, and the work of securing the right of way from property owners will be undertaken at once.

OIL.

Goldfield, Nev.—Louis Bond has returned to Goldfield from Mono Lake, Cal., and reports that oil has been struck on the shores of that lake. A company has been formed to drill wells there, and if a large flow of oil is encountered, the oil will be piped a distance of nearly 100 miles to this city.

Newport, Cal.—Pumping is being done on well No. 1 on the mesa. The result is about ten per cent of oil. When the water is under control, as it is expected it will be in a short time, the output of oil will be larger. The result of the work on No. 1 is practically an assurance that the mesa field's future is assured. No. 1 looks like a forty or fifty barrel well.

Los Angeles, Cal.—The Los Angeles Union Oil Company has filed suit in the Superior Court against the city asking for a return of $42,920, which sum is claimed to have been paid by it for taxes. The company declares an assessment was levied on its corporate franchise in March, and that this action is void and the taxes paid under protest.

Bakersfield, Cal.—It has been announced at the local office of the Standard Oil Company that fifty cents a barrel would be paid for oil on daily runs. That is, oil which would be delivered without a previous contract and marketed daily to the Standard. This offer is extended to producers in the Kern River district, Midway and McKittrick fields. It is understood that quite a large amount of oil will be sold to the Standard at this figure.

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THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., FEBRUARY 29, 1908 No. 9

HIGH HEAD FRANCIS TURBINE AT CENTERVILLE POWER PLANT.

Mr. Jas. H. Wise, assistant hydraulic engineer of the California Gas and Electric Corporation, read a paper on the "Centerville Hydro-Electric Power Installation of the California Gas and Electric Corporation," at the bi-monthly meeting of the San Francisco Association of the American Society of Civil Engineers, on Friday, February 21, 1908. In the course of the reading, and in the discussion that followed, Mr. Wise described the head works, canal, pipe line, power plant and turbine of this installation as is summarized below. It includes a description of the highest head Francis turbine yet installed, a 9,700 horsepower unit under an effective head of 565 feet, and direct connected to a 5,500-kilowatt generator. works, canal, pipe line, power plant and turbine of this installation as is summarized below. It includes a description of the highest head Francis turbine yet installed, a 9,700 horsepower unit under an effective head of 565 feet, and direct connected to a 5,500-kilowatt generator.

The Centerville power plant is operated in parallel with the ten other hydro-electric plants of this corporation, as well as with their three steam plants and the gas engine set at Martin's station. These give a total of 133,132 available horsepower, of which an output of 93,150 is obtained from the hydro-electric plants. The location of all these is best shown by the accompanying map, the Centerville plant being thirteen miles northeast of Chico. It feeds directly on to the line leading from De Sabla, and the two plants are run in parallel with the rest of the system. A description of the De Sabla plant, together with a paper by Mr. F. G. Baum, on "High Potential Long Distance Transmission and Control," appeared in the "Journal of Electricity, Power and Gas," of November,. 1904.

Centerville makes a second use of the water supplied De Sabla. This is taken mainly from Butte Creek, having a capacity of three thousand inches, by the Cherokee ditch, supplemented by 3,000 inches more from the Hendricks ditch, the latter being brought over from the west branch of the Feather River. After operating the De Sabla power plant, this water is again taken out, one-fourth of a mile below, and is carried 8.3 miles by ditch and flume to Centerville. Diversion is secured by means of a cyclopean concrete dam 15 feet high, 3 feet wide on the crest, and 90 feet long, which is arched up stream. This canal consists of 6.7 miles of ditch and 1.6 miles of flume. It has been reconstructed from an old mining ditch, having a capacity of 45 second feet, so as to deliver 175 second feet. Full details of this work will be given in an early issue of the "Journal," it being a digression from the main topics here discussed.

The canal terminates in a reinforced concrete forebay, 18x25x20 feet, three hundred feet above which is a settling basin and grizzly. One 36-inch and 42-inch pipe of riveted steel, and two 24-inch pipes lead from the forebay 2,566 feet to the power house, where they are all connected by means of a multiple casting which delivers water to a 900-kilowatt impulse unit and to a 5,500-kilowatt turbine unit, the latter being connected by means of a 45-inch gate and taper piece to this "Y" casting, which is the confluence of these three pipes.

The Centerville plant started running in December, 1902, the original installation consisting of one 900-kilowatt and two 400-kilowatt units, all impulse wheels operating under a static head of 577 feet. The two 400-kilowatt units have been replaced recently by a 5,500-kilowatt Francis turbine, occupying the same floor space. For the new installation the concrete walls of the power house were raised and steel roof trusses substituted for the wooden ones. The accompanying interior view shows that at one end of the building there is a transformer room, and at the other end the machine shop, and between these the generating units. The building stands on a solid sandstone foundation, and is fireproof.

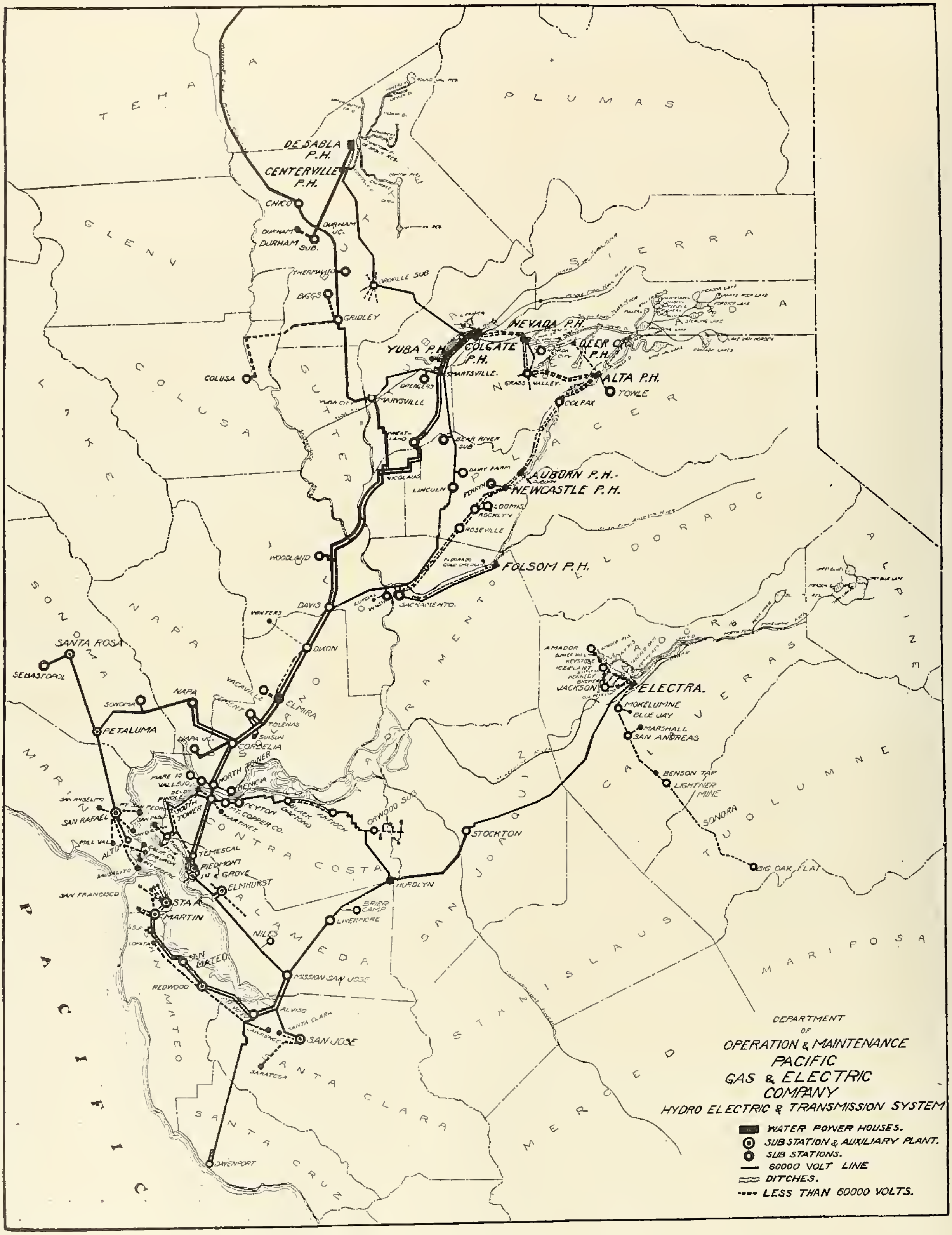
The Francis turbine, which has been in successful operation during the past three months, is of the radial inward flow, single axial discharge type, with horizontal shaft. It operates under a total head of 591 feet from the surface of head water to normal tail water. At full load, with 400 revolutions per minute, this is equivalent to an effective head of 565 feet. Owing to the limited capacity of the generator, 5,500 kilowatt, the wheel has never exceeded 8,200 horsepower, though the rating is 9,700 horsepower. The discharge is 155 feet per second, and the total weight 117,000 lbs. The guaranteed efficiency at full gate is 80 per cent, at three-quarter 82 per cent, and at one-half 77 per cent.

The spiral casing is of cast steel, made in two parts, provided with a quarter turn discharge to the draft tube, and equipped with a pressure regulator. The turbine shaft consists of one piece of forged steel provided with a swell for receiving the runner and with forged flanges forming half of the coupling for direct connection to the generator. The runner is of cast steel with twenty vanes.

Twenty-four pivoted guide vanes are connected to a cast steel speed ring, designed to gradually bring the speed of the water up to that acquired by the guide vanes. This shifting ring is connected to the governor rocker shaft by lever arms.

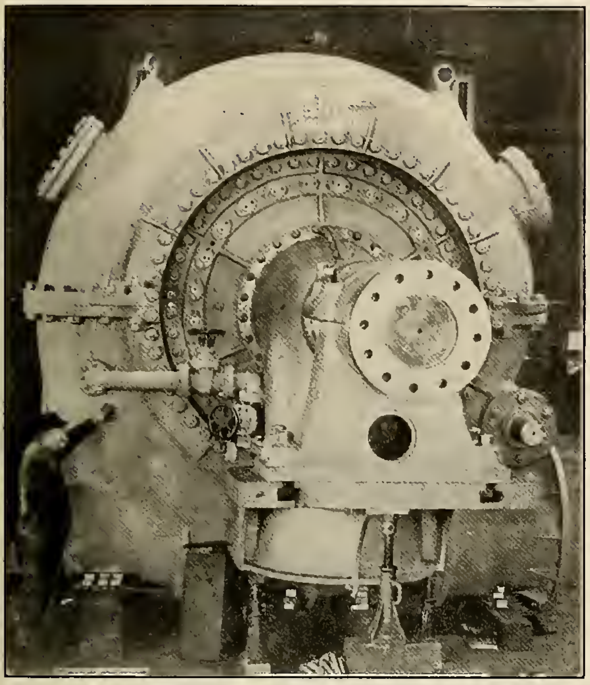
A thrust bearing of cantilever type takes up any end thrust caused by sudden changes in the load, being supplied with oil under pressure. The other end of the shaft is supported by a ring oiling bearing of the ordinary pedestal type on the discharge side of the wheel.

The discharge pipe is bolted to the riveted steel draft tube, which leads to the concrete lined tunnel, as shown in the general section.



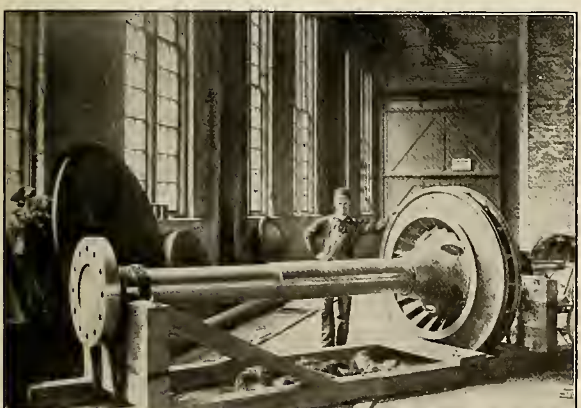
CALIFORNIA GAS AND ELECTRIC CORPORATION GENERATING AND DISTRIBUTING SYSTEMS.

This also shows the location of the pressure regulator, or relief valve, which is governor operated, and is designed to relieve the pipe line and wheel casing of excessive pressure and water hammer when the vanes are closed. If the



9700 H. P. FRANCIS TURBINE.

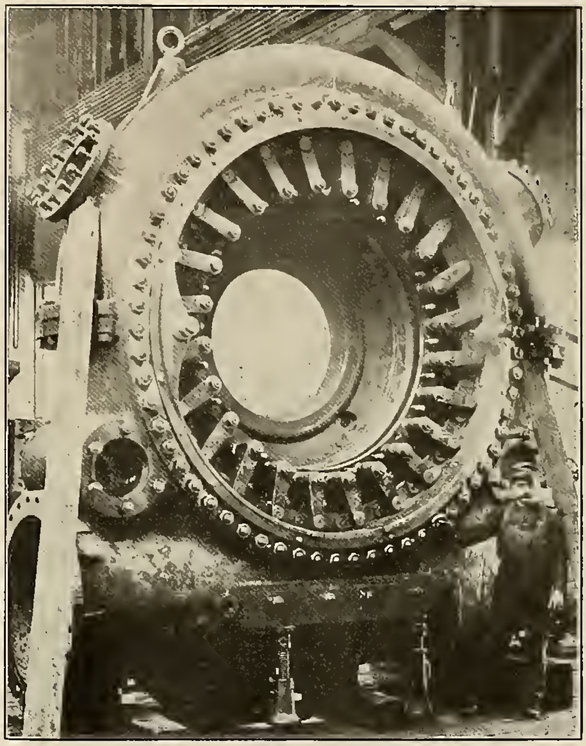
guide vanes are suddenly closed, the pressure regulator discharge is opened, but has a general tendency to close, doing so gradually through the agency of a relay valve and dashpot arrangement. If the vanes are closed slowly, the regu-



RUNNER FOR 9700 H. P. TURBINE.

lator does not operate. The dashpot can be cut out, and the pressure regulator will then act as a by-pass, being closed when the vanes are open, and vice versa. Tests were made of the relief valve at the time the turbine was first put in operation. The machine was running at full load, or discharging about 155 second feet, the vanes were suddenly closed, the relief valve opened at the same time, and closed after a period of 30 seconds. The total rise in pressure was 16 pounds above the static, or 28 pounds above the working pressure. With conditions at 1,000 kilowatt load, the time of closing was 5 seconds, and the rise in pressure above static was 41 pounds, or 42 pounds above the working pressure. The guide vanes and relief valve are operated by a Type N Lombard governor, which is connected to the rocker shaft by suitable pinions and a segment, the relief valve being lever connected to the bell crank of the shifting ring lever.

With this type of wheel it is necessary to have a load

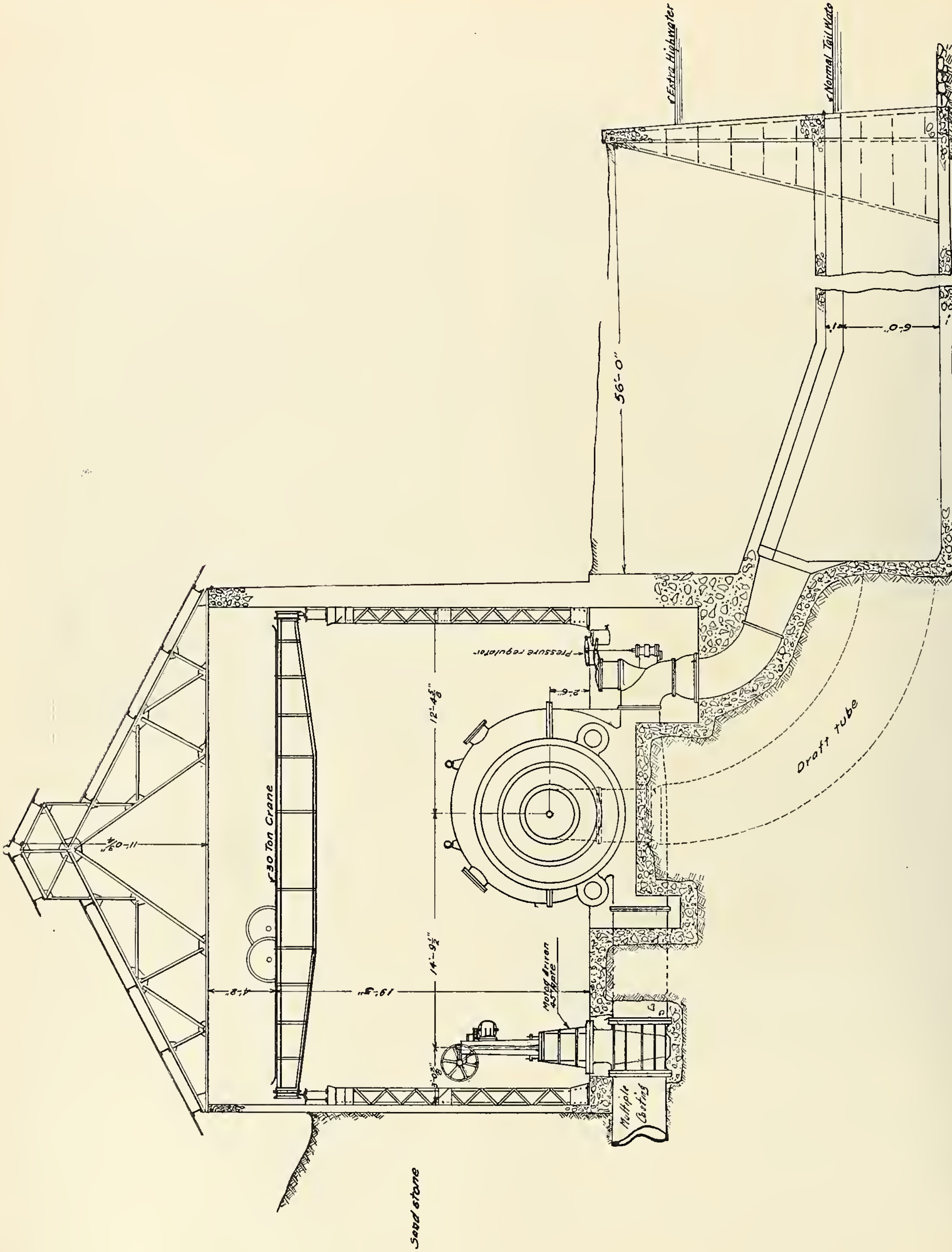


SHELL AND GUIDE VANES.

limiting device for regulating the gate opening. For if additional load comes on the system, the governor would ordinarily open the guide vanes, possibly to such an extent that more water would be used than the canal at that time may be furnishing. Or the generator may become overloaded, as the capacity of the turbine is greatly in excess of that of the generator. For this purpose, Mr. J. P. Jollyman, superintendent of electrical construction, devised a load limiting device of an adjustable connection between the valve-stem pinion and the rocker shaft of the anti-racing mechanism on the governor. This device works admirably and enables the operator to adjust the governor so that the wheel will not exceed any desired load. The machine is provided with current transformers included in the armature circuit so as to automatically trip turbine out of commission in case of line or machine short circuit.

The governor oil pump is of the triplex 4x6-inch type, furnished by the Lombard Governor Company, and is run by a 7.5 horsepower induction motor.

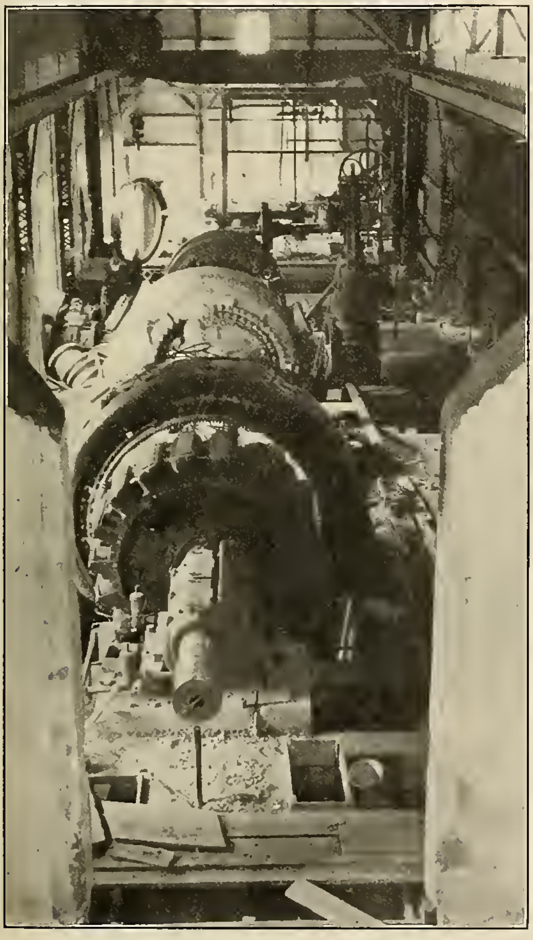
The generator is a 5,500-kilowatt, 3-phase, 60-cycle, 2,400-volt, 400 revolution per minute machine, furnished by the Stanley G. I. Electric Manufacturing Company. The revolving element is supported on a 16-inch shaft between two oil-



GENERAL SECTION OF FRANCIS TURBINE AT CENTERVILLE PLANT.

ing ring bearings. The generator and water wheel shafts are connected by a bolted flange coupling. Excitation is secured from a water wheel, motor exciter set of 60 kilowatt capacity.

Six 840-kilowatt, and three 360-kilowatt shell-type water-cooled transformers complete the main features of the installation. The circulating water for the transformers is used under a fifty-foot head, and is piped from a reinforced concrete tank, ten feet in diameter, and six feet deep, with four-inch walls. Clinton wire fabric was used for reinforcement, and the tank was absolutely water-tight without the use of any water proofing material.



INTERIOR OF CENTERVILLE POWER PLANT.

The high tension lines (60,000 volts) are led from the transformer room out of the end of the building to a reinforced concrete fireproof switch house provided with "Baum" high tension switches and open air switches, for cutting on or off the de Sabla lines. The switches are lever controlled from the switch board.

Mr. J. P. Jollyman, superintendent of electrical construction, under the direction of Mr. C. F. Adams, assistant electrical engineer, had charge of the electrical installation. Mr. Kramer, of the Allis-Chalmers Company, assembled the turbine, and the hydraulic and civil engineering work was carried on under the direction of James H. Wise.

The turbine was furnished by the Allis-Chalmers Company of Milwaukee, and was designed by Mr. Arnold Pfau, their engineer. It was through the efforts of Mr. F. G. Baum, formerly chief engineer of the California Gas and Electric Corporation, that this departure from the customary turbine practice was made.

In closing, the speaker showed the field to which the so-called high head turbine is best fitted.

For the past few years the general tendency has been on large systems to install electrical units of large capacity and high speed for the sake of economy in first cost, operation and maintenance. Impulse wheels are adapted to such installations with pressure heads of say 800 feet and upwards (with reference to units of 5,000 kilowatts and over, and not less than 300 revolutions per minute). But for low heads, or for medium heads, say in the neighborhood of 300 to 600 feet, the turbine is better fitted for large units, as can be shown by comparison, taking the installation just described.

The quantity of water used is approximately 155 second feet. If impulse wheels were used, there would be required two wheels with nozzles of about nine inches in diameter, or three wheels with about seven and one-quarter-inch nozzles, the latter would be allowable, but a speed of 400 revolutions per minute would be entirely out of the question, for with that speed, a pitch diameter of about 4 feet would be necessary (considering the speed of the pitch circle 46 per cent of the spouting velocity). That means that the disc would have a diameter of say 3 feet, the buckets on the other hand would have to be about 18 inches in width, and such a combination of large buckets on a small disc would be neither mechanical nor efficient.

With a 300 revolution per minute machine, the pitch circle would be a little over 5 feet, or a disc diameter of about 4 feet, but with the same size buckets, which is still an undesirable arrangement. We may arrive at the conclusion then, that at least three impulse wheels would be necessary, the speed being 250 revolutions per minute. We would, therefore, have three wheels instead of one, and a more expensive generator.

With the turbine, on the other hand, a single wheel only is necessary, the speed if desirable could be increased to about 500 revolutions per minute. Also generators of larger capacity than 5,500 kilowatts could be used.

Furthermore, we should not lose sight of the fact that by means of a draft tube, the turbine can gain additional head over that of the impulse wheel, for in the installation just cited, the impulse static head is 577 feet against the total head on the turbine of 591 feet, an increase of about 2.4 per cent, which means 2.4 per cent more power for the same quantity of water. The reader may arrive at his own conclusions.

It is proposed that the word "kelvin" be laid before the International Standardization Commission as the kilowatt-hour unit, thus honoring the memory of the late Lord Kelvin and giving a short expression for the cumbersome kilowatt-hour as the English Board of Trade unit.

COMPRESSED AIR CALCULATIONS.*

By E. A. Rix, Mem. Am. Soc. C. E., Mem. Am. Soc. M. E.

Fellow Students:

The great progress in the Arts and Sciences is made for commercial reasons and by people who are seeking either gain or a livelihood. The trade catalogue is one means by which advance information is given the public, and in it the data and tables and scientific information are mostly theoretical. It is not considered prudent by business men to take the public into their confidence and give them the practical co-efficients which have cost years, much money, and hard work to acquire. For this reason, catalogue information is ofttimes very misleading, and is valuable only as a means of comparison.

No matter what theoretical engineering course we take, to be valuable to the community, we must all take a post-graduate course of experience and become commercial engineers. The sooner we reach that degree, the better for ourselves and everybody concerned. Theoretically and actually, you may have a million dollar ore body, but if it costs more per ton to realize its value than it yields commercially, there is not a cent in that ore-body. That, after all, is the only fact we wish to know, and we want to know it beyond a peradventure.

It seems to me, therefore, that if I am honest in my desire to help you, I must loosen up and give you practical commercial co-efficients, show you how we safeguard our own interests, and at the same time satisfy those with whom we deal. And finally, it seems to be about the best way in which one can repay this University for the benefits which he has received from a four-years' training.

Before we undertake to solve a problem which I shall present for your consideration, I shall give you some of the practical data which I use to make these calculations.

During the last twenty years, I have kept a log of all the compressed air plants I have tested, and also the actual performances of a great number, covering almost every kind of compressor and compressed air motor or tool, and I have averaged all the indicator cards taken from the various compressors used in mining work and compared the indicated horsepower with the actual power required, comparing this with the displacement of the compressor cylinders, I have concluded that for a safe and sane power factor, we must allow 20 horsepower for every one hundred cubic feet of cylinder displacement, to compress air from atmospheric pressure to 90 or 95 lbs. receiver gauge pressure at sea level.

I have made my calculations on these pressures because they are the standard pressures now used for pneumatic work, and nearly every machine and motor is constructed for these pressures. Twenty horsepower means brake horsepower, i. e., the power delivered at the shaft of the prime mover.

If you consult tables in any engineering magazine or trade catalogue, on air compressors, you will note that the power claimed to do certain work is much less than the figure which I give you, and in explanation, it must be noted that these tables are theoretical, and do not take into account the mechanical efficiency of the compressor, nor losses due to volumetric efficiency of compressors.

These figures are, therefore misleading, and should be avoided except to use as comparisons between one machine and another.

It is most unfortunate that the public is not given the results of working tests upon plants of all descriptions running under ordinary conditions, as such information is much more valuable than the records of official tests, which are usually made under special conditions by experts at the most satisfactory load—a set of conditions not often realized.

You must have a safe margin in your calculations so that neither you nor those for whom you are installing a plant will be disappointed, and I, therefore, have given you 20 horsepower per one hundred cubic feet of cylinder displacement as a figure that will never get you into trouble, and at the same time, it is not too generous. It may also be noted that it would be just as well in small plants to make no distinction between single and two stage machines. By small plants, I mean up to 400 cubic feet capacity.

Second.—Remember that a compressed air cylinder will never give a quantity of air equal to the volume swept by the piston, for the reason that such things as clearance, leakage, temperature, piston speed, etc., reduce the theoretical quantity so that it is best to figure about 80 per cent volumetric efficiency for the average mining compressor. Many do not give 60 per cent and some 90 per cent.

Third.—In using compressed air at 90 lbs. pressure cold, it will take 24 cubic feet of free air per minute to give one horsepower in plain slide valve engines, and 15 cubic feet with good expansion valve gearing, and between these two limits will lie all the various types of engines. If the air be reheated, to about 300 degrees Fahrenheit, it will reduce the above quantities about one-third. In one hoisting engine which we installed, having compound Corliss cylinders, and where the air was heated to 400 degrees Fahrenheit before entering each cylinder, it required between 7 and 8 cubic feet only for one horsepower. Most mines, however, use cold air and prefer the power loss to the trouble and expense of the installation and maintenance of reheating apparatus.

Fourth.—The tables set forth in the trades catalogues for the air consumption of standard piston rock drills are fairly accurate and are generally in terms of the compressor cylinder displacement.

Fifth.—For operating ordinary station and sinking pumps of the direct acting type, which is the ordinary stock pump usually used in mining operations, it will be safe for you to calculate that one cubic foot of free air compressed to ninety pounds gauge pressure will do 135 foot gallons of pumping.

Sixth.—That ordinary mining hoists have a mechanical efficiency of about 75 per cent.

Seventh.—For the determination of pipe sizes, losses of pressure and terminal pressures for compressed air transmission, I use the Johnson formula, which is very satisfactory:

$$P_1^2 - P_2^2 = \frac{.0006V^2L}{A^5}$$

Wherein P_1 = absolute initial air pressure.
P_2 = " terminal air pressure.
V = free air equivalent passing through the pipe.
L = length of pipe in feet.
A = diameter in inches.

This formula is quite simple to solve.

With these facts at hand, we can now readily calculate the problem we shall consider as follows:

PROBLEM.

A mine having a water power distant 5000 feet wishes to generate compressed air and transmit it to the collar of the shaft for operating purposes. The work to be performed is as follows:

100 tons of ore and waste to be hoisted in 20 hours.

30 gallons of water per minute to be pumped either at a station or a sinking pump.

5—2¼ standard piston rock drills to be operated.

3 air hammer drills to be operated.

General Conditions:

Depth of shaft, 600 feet.

Weight of skip and rope, 1,000 lbs.

Weight of ore hoisted, 1 ton.

Initial air pressure, 95 lbs.

Final air pressure, 90 lbs.

Altitude, sea level.

Geared hoist and unbalanced hoisting.

Required:

Size of compressor.

Diameter of air pipe.

*Published by courtesy of Mining Association of the University of California, before which this paper was read February 19, 1908.

Brake horsepower.
Altitude factors.
Re-heating co-efficients.

Note.—In problems of this kind, we must reduce all of our requirements to cubic feet of free air because free air is the basis for all power calculations.

To determine the free air required for hoisting: If 100 tons of ore and waste are to be hoisted in 20 hours, the hoisting will be done at the rate of 5 tons per hour, and inasmuch as each load hoisted contains one ton, it follows that there will be a load hoisted every 12 minutes. Of course, we know that an absolute schedule of 12 minutes between hoists can scarcely ever be carried out, for the intervals may be shorter during one hour and longer during another, or stop altogether, but the only way to figure it is on a regular basis, and after that is determined, allowance one way or another can be made for any irregularity.

The load being 2,000 lbs. of material and 1,000 lbs. of rope and skip, makes a total of 3,000 lbs. which is to be hoisted 600 feet. 3,000 lbs. lifted 600 feet will require 1,800,000 foot pounds of work, or 54 horsepower, theoretical. Inasmuch as the hoist has a probable efficiency of 75 per cent, the 54 theoretical horsepower becomes 72 brake horsepower actually required.

Using cold air, it requires, as we have mentioned before, 24 cubic feet of free air per horsepower. Then $24 \times 72 = 1,728$ cubic feet of free air which the hoist will consume to make one lift. This, you will note, gives us direct results without taking into consideration the element of time or the dimensions of the hoist. If we made a hoist every 12 minutes, and it required 1,728 cubic feet to make a hoist, then the compressor must furnish 144 cubic feet of free air per minute continuously, and we must have storage capacity sufficient to accumulate the air between hoists. Right here is the vital point of hoisting economically with compressed air.

Let us assume in our problem that we hoist at the rate of 300 feet per minute, then it will take two minutes to make the lift, and the hoist will be lowering and idle during the next ten minutes. During this ten minutes, the compressor is delivering 144 cubic feet of free air per minute, or 1,440 cubic feet total, which must be stored.

If the hoist is none too large for the work, you will find that if the pressure in the receiver drops more than one atmosphere or from 90 lbs. to 75 lbs., that the hoist will not operate in a satisfactory manner. Then, in our problem, if we must draw 1,440 cubic feet from the receivers at a drop of one atmosphere in pressure, the receivers must have a cubic capacity of 1,440 cubic feet, and if the hoist is amply large so that it will still operate after the receiver pressure has dropped two atmospheres, or from 90 lbs. to 60 lbs., then the receiver capacity can be one-half of 1,440 or 720 cubic feet, but it is not wise to go below this pressure, because it will effect too materially the pressure required for operating the other machinery.

For a first class job, install receivers having a capacity equal to the storage required at one atmosphere pressure. Right here let me say that large receivers cost less in proportion to their storage capacity than small ones. For example: A carload consisting of four receivers 54 inches in diameter by 30 feet long, containing about 2,000 cubic feet, costs at the present time about $1,600, while the same storage in ordinary receivers 48 inches in diameter and 12 feet long, would cost about $2,200. It is better to invest more money in receivers and less in compressors because the smaller compressor takes less power at the peak, and most power bills are figured on a constant peak.

If you install a plant and the receiver capacity is too small, you can always determine the proper quantity of storage by running the compressor with the unloader cut out, and if the receivers blow off between hoists and the pressure drops more than 15 pounds during hoisting, add more receiver capacity until it will not blow off nor drop more than 15 pounds. If you arrive at the point where it does not blow off and the pressure does not fall to 15 pounds, then slow down the compressor until the desired drop is reached, and you will be operating your plant at the most economical point. Then cut in the unloader again and let it work when it will. An unloader only saves wear and tear on the compressor where you buy power at the peak load, as happens in most cases, but does not affect your power bill.

Let us go back now to our problem. We find, therefore, that 144 cubic feet per minute is required for hoisting. Now, while we have allowed four hours in twenty-four, or an hour and twenty minutes on each shift for hoisting and lowering men, timbers, supplies, etc., it is entirely probable that at least once every hour some one will be going up and down the shaft, and it would be practical, therefore, to say that the hoist would handle six loads per hour instead of five, and we must therefore add twenty per cent to the hoisting requirement, making, say, 175 cubic feet instead of 144.

To determine the amount of compressed air required for pumping: For pumping 30 gallons per minute 600 feet, requires 30×600 or 18,000 foot gallons of work. If one cubic foot of free air at 90 pounds gauge pressure will give 135 foot gallons of work, we shall require 133 cubic feet of free air for the pumping. This requirement is constant.

To determine the amount of compressed air required for drilling: Five 2¼-inch rock drills will require 50 feet of free air each, or 250 cubic feet, and three air-hammer drills will require 25 cubic feet each, or 75 cubic feet. To get these amounts, take about eighty per cent of the requirements as stated in rock-drill catalogues, which always give quantites in compressor-cylinder displacement which do not deliver on an average within twenty per cent of their displacement, excepting in large machines.

Our total requirements will therefore be:

Hoisting	175 cubic feet
Pumping	133 cubic feet
Drilling	325 cubic feet
Total	633 cubic feet

This 633 cubic feet does not take into consideration any ordinary pipe leakage in the hoisting works and below ground, and in conducting this air from a distance, inasmuch as our problem calls for a transmission of 5,000 feet, it would be well to allow a leakage of five per cent on the entire system. This would bring our requirement up to 665 cubic feet, and if we allow that our compressor will give a volumetric efficiency of at least eighty per cent, we must have a cylinder displacement of 830 cubic feet per minute.

You will remember that our power factor was 20 horsepower per 100 cubic feet; consequently we must have 166 horsepower delivered on our water-wheel shaft to drive this compressor.

Finally, we must determine the size of the pipe, allowing five pounds drop in pressure for friction loss. You will remember the formula

$$P_1^2 - P_2^2 = \frac{.0006\,V^2 L}{A^5}$$

P_1 the initial pressure absolute$=95+14.7$, or 109.7, and its square is 12034.

P_2 the terminal pressure we have stated shall be 5 pounds less than the initial or 90 pounds, or 104.7 absolute and its square is 10962.

The difference between these two, or—

$$P_1^2 - P_2^2 = 1072.$$

Substituting this in our equation, and also the values for L and V, we have—

$$1072. = \frac{6 \times 5000 \times 633 \times 633}{10000 \times A^5}$$

Reducing, we have $1072 \times A^5 = 3 \times 633^2$, or

$A^5 = 1121$

$A = 4$-in. pipe.

We have now to figure the size of the compressor required. If you happen to have tables and catalogues at hand, it will be

an easy matter to look up a satisfactory compressor having a displacement of 830 cubic feet, but if such literature is not at hand, the size of the compressor may be determined as follows:

It almost goes without saying that you would select a two-stage compressor for anything over 400 cubic feet capacity. This two-stage compressor will have a low-pressure or gathering cylinder, wherein the air is compressed to about 25 pounds, and a high-pressure cylinder where the air at 25 pounds after it has been cooled will be compressed to 90 or 95 pounds pressure. The reason a two-stage machine is selected is because it has a higher volumetric efficiency, requires less power to operate it, is easier to lubricate on account of lower temperatures and has less strains on the mechanism.

The first thing to consider is the speed at which you will operate the compressor, and this will be dictated by many things. If you have a limited amount to expend, you will naturally select as high a working speed as possible, because the higher the speed, the smaller the compressor.

Again, you may have to take the future into consideration, and you may want more air later on, as the shaft goes deeper or more water is encountered. You would then naturally select such a speed as would give you the margin of additional power required.

You may take 150 revolutions per minute as the maximum for compressors from 400 to 1,500 feet capacity, and 100 revolutions per minute as a speed that will give you a fifty per cent margin for the future, so let us assume that the mine in question has a future, and take 100 revolutions per minute, If our requirement is 830 cubic feet per minute we shall then require an intake or compression cylinder which will give us 8.3 cubic feet per revolution, and inasmuch as the cylinder is double-acting—that is to say, makes two displacements per revolution, the cylinder must have a cubic capacity of 4.15 cubic feet.

Experience dictates that the average compressor cylinder is built for the following strokes and capacities:

6-in.	stroke	up to	50-ft.	capacity
8-in.	"	"	100-ft.	"
10-in.	"	"	200-ft.	"
12-in.	"	"	500-ft.	"
16-in.	"	"	700-ft.	"
18-in.	"	"	1500-ft.	"
24-in.	"	"	2500-ft.	"

Our compressor will therefore be best suited by an 18-inch stroke, or 1.5 feet. If the capacity is 4.15 cubic feet and the stroke 1.5 feet, the area of the cylinder will be $\frac{4.15}{1.5}=2.75$ sq. ft. or 397 square inches, which is the area of a 22½-inch cylinder. The low-pressure cylinder will therefore be 22½×18.

It is very evident that if we have two cylinders to do our compressing, that there is no good reason why one cylinder should do more work than the other, and there is a very good reason why the work performed by these cylinders should be equal, viz.: because the total work and temperature developed will be at a minimum, just why—would lead us into mathematics, and so you must take the statement as a fact.

There is also the mechanical reason that the strains on the machine will be at a minimum, and if you construct the compressor of the duplex type, both sides will be alike, except as to the cylinders. It can be easily shown by algebraic method that if our two cylinders perform equal work, the intermediate pressure must be a mean proportional between the initial absolute pressure and the final absolute pressure, and the cylinder ratios will be as the ratios of either the high or initial absolute pressure to the intermediate. In other words, to put this in such shape that you will easily remember it,

If P =absolute initial pressure
P_1 =absolute intermediate pressure
P_{11}=absolute final pressure
then $P_1=\sqrt{P\times P_{11}}$

Take our example: Our initial pressure is atmospheric or 147 absolute. Our final pressure is 95 pounds gauge or 109.7 absolute. The intermediate pressure will then be $P_1=\sqrt{14.7\times 109.7}$ or 40 pounds absolute=25.3 lbs gauge pressure. Our proportion then stands 14.7:40::40:109.7, which represents a ratio of

$$\frac{40}{14.7} \text{ or } \frac{109.7}{14.7} \quad 2.74$$

The cylinder ratios will therefore be identical with the pressure ratios and our high-pressure cylinder will have a capacity of $\frac{1}{2.74}$ of the low pressure. The strokes being the same, the area of the high pressure cylinder will be $\frac{1}{2.74}$ of the low pressure, which was 397 square inches. Dividing this by 2.74, we have 145 square inches as the area of the high-pressure cylinder. This corresponds to a diameter of 13½ inches. The compressor will then be a 22½-inchx13½-inchx18-inch stroke, and you will be justified in taking the nearest size to this that the manufacturers can supply.

You will note that as the altitude increases, the initial absolute pressure diminishes, and as the final pressure remains the same, the pressure ratio grows larger as the altitude increases. For example: At 10,000 feet the atmospheric pressure is 10 pounds instead of 14.7 pounds, and if you go through the same calculations that we have just made, you will find that the cylinder ratios will be 3.3 instead of 2.74, and this will make the high-pressure cylinder only 12½ inches in diameter instead of 13½ inches in diameter, and the intermediate pressure will be 18.3 pounds instead of 25.3 pounds. Such a compressor would not, however, be able to do the work contemplated in the problem we have considered, for the reason that while the weight of air necessary to do work remains practically the same for reasonable altitudes, the capacity of the compressor diminishes as the altitude increases. It is true the volume remains the same, but it has not the weight and therefore you must increase the size of the cylinder required at sea level by the ratio between the ratio of compression at sea level and the ratio of compression at altitude.

In our problem, the ratio of compression at sea level is 7.5 and the ratio of compression at altitude of 10,000 feet is 11. The sea-level compressor must be increased therefor, $\frac{11}{7.5}$ or 1.47 times, to give the same weight of compressed air at 10,000 feet altitude, or, to put it even more simply, it will take 11 strokes of the same-sized compressor piston at 10,000 feet altitude to give the same compressed air or to do the same work as 7½ strokes will do at sea level.

In our problem this would make a low-pressure cylinder of 27 inches instead of 22½ inches, and a high-pressure cylinder of 15 inches instead of 13½ inches. In other words, this altitude compressor is nearly fifty per cent larger to do the same work.

A proper understanding of these simple calculations will enable you to check up compressor sizes and proportions, and no one could furnish you with a sea-level compressor for an altitude one, and *vice versa*. We have assumed eighty per cent volumetric efficiency in this problem, but if the compressor happens to be a slow-speed, mechanical-valve machine, ninety per cent could be assumed. The figures I have given you are safe, and taken from average plants, and it will be necessary for you to use your judgment in assuming a higher or lower factor.

To determine the amount of compressed air required for re-heating: It is practical to re-heat air from 300 to 400 degrees Fahrenheit in various ways and great economy realized, especially for pumping and hoisting, and if it is possible you may reduce the quantities of cold air which we have figured for this work by the ratio of the atmosphere to the compressed air temperature absolute. Thus, if the atmosphere is at 60 degrees Fahrenheit or 520 degrees absolute, and the compressed air is used at 300 degrees Fahrenheit or 760 degrees absolute, then the cold air volume for your work may be taken at the

ratio of $\frac{520}{760}$, or about seventy per cent, thus making a saving of thirty per cent.

In conclusion, let me caution you about being led astray by that Will-o'-the-Wisp "Efficiency" when you come to choose between compressed air and some other power to do mining work. "Utility" should always be the standard for comparison.

It is seldom that any set of conditions call for the exclusive use of one kind of power, and it is not good engineering to make an installation the victim of any fad or prejudice. Whether it be steam, electricity, water power or compressed air, or a combination of any or all of them, let the sole and only qualification be determined on the basis of commercial efficiency.

ELECTRIFICATION OF RAILWAYS.*

By Dr. Gisbert Kapp.

(Continued.)

Classification of Electric Railways.

We may classify electric railwavs either by the kind of current supplied to the train or by the kind of motors used. It is obvious that the two classifications need not necessarily be identical. We might, for instance, supply single-phase current to the train, and by using converting apparatus on the train use three-phase motors or continuous-current motors. Taking, however, the motors as the basis of classification, we have in chronological order: (1) the continuous-current system; (2) the three-phase system; (3) the single-phase system. In the oldest system, which at present also has the greatest mileage, the motors are of the series type, and are worked on what is known as the series-parallel control. That is to say, by means of a special multiple-contact switch the motors are put in series at the start, and as the train gathers speed their connection is gradually changed to parallel, the finer subdivisions of speed being obtained by variable resistance in the armature circuit and by varying the magnetic flux in the field system. A further development is the so-called "multiple-control system," which, although first used with continuous-current motors, has also been adapted to the other motors. Both the series-parallel and the multiple control are the invention of Mr. Sprague, and have been adopted in one form or another by all makers of electrical equipment. The leading idea is this: Each motor coach is provided with its own equipment of switches, called "contractor," which regulate the supply of current to the motors of that coach alone. Any desired number of such motor coaches can be made up into a train with or without the insertion of "trailers"—that is, coaches not equipped with motors. All the coaches are joined by a multiple cable which carries the relay currents for working the contactors. The ends of this control cable, also called the "train line," are connected from coach to coach by coupling sockets, much in the same way as the brake pipes in our railway trains are connected. In each motor coach there is a master controller by which the relay currents for working the contactors are regulated, and it is thus possible to work the whole train from any motor coach. Each motor coach forms an independent unit, taking current from the third rail or overhead trolley wire as if it were running alone, but, by reason of the electric control, it takes the current exactly in the same way as any other motor coach in the same train, so that all the motor coaches take an equal share in propulsion. In this manner a large part of the total weight of the train is adhesive weight, and it is quite easy to get an acceleration as high as three feet per second per second. The high acceleration is of great advantage in the tube railways and other urban lines where, on account of the small distance between stations, a rapid start is essential for quick travel. The multiple-control system has also the advantage that the efficiency of control is quite independent of the length of the train, that trains can be made up without any need to observe a special grouping of coaches, and that in the event of one motor equipment failing it can be cut out of circuit, and its coach will then simply become a trailer, the other motor coaches working as usual. To reduce the stress on drawbars, it is customary to make the first and last coach motor coaches, but this is not essential to the system.

The General Electric Company of America have arranged an equipment of a motor coach for multiple control for a line where part of the way continuous current is supplied whilst the remainder receives single-phase alternating current. Such a condition of supply may arise where the main-line system joining two towns has to be interlinked with urban systems at either end. If the urban lines are worked by continuous current, the main-line train must be fitted to take this also, whilst for the main line proper high-tension alternating current is the only commercially possible method of power supply. The single-phase commutator motor can also be worked with continuous current, and part of the equipment, such as resistances and contactors, can be used for both. There are only some minor alterations necessary when passing from one kind of supply to the other, and these are made by the turning of a switch handle. There is a master controller at each end of the coach. The propulsion is effected by four motors, which at starting are all put in series connection. When half speed has been reached the connections are altered to two in series and two parallel, and when nearing full speed all the four motors are put in parallel. Since the motors are series wound the speed adjusts itself within wide limits to the load—that is to say, with the controller in the same position the speed will be much higher on the level than on an up grade. The same is the case with commutator single-phase motors. Also with such an equipment the motors run slower up hill than on the level, and the demand for power does not vary within quite so wide limits as would be the case were the run made with constant speed irrespective of gradients.

Such a condition of working is, however, not only possible with three-phase motors, but it is their normal condition, and if we wish to get away from it we must apply special means. The speed of a three-phase motor is only very slightly influenced by the load. When running loaded the speed may drop some three or four per cent, and this is so small a variation that we can say the speed is independent of the load. It depends only on the construction of the motor (number of poles, gear ratio, and diameter of wheels), and on the frequency of the supply current. This, of course, is constant. At starting, resistance is inserted into the secondary circuit and gradually withdrawn as the motor speeds up, but once all the resistance is withdrawn, and the motor runs at the full speed corresponding to the frequency, it will keep that speed whatever the gradient of the line may be. There is no possibility of running faster to make up lost time, but there is also no possibility of racing downhill; the train runs its even pace.

(To be continued.)

*Lecture delivered before the Royal Institution of Great Britain.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 31, 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX FEBRUARY 29, 1908 No. 9

EDITORIAL.

THE FRANCIS TURBINE.

The world's largest and highest head water turbine has been in successful operation for the past four months at the Centerville plant of the California Gas & Electric Corporation. This is a Francis single wheel, rated at 9,700 horsepower at an effective head of 565 feet, direct connected with a 5,500-kilowatt generator. It occupies the space formerly required for two 400-kilowatt impulse wheels, and is operated in parallel with the ten other hydro-electric plants of this corporation, making a second use of the water that has already developed 14,000 kilowatts at the De Sabla plant under a head of 1,530 feet. As the entire system is controlled largely from the plant at Electra, this installation does not require accurate regulation. Our readers will find much of interest in the paper we summarized this week, as read by Mr. James H. Wise, before the local Association of American Civil Engineers. Much credit is due to Mr. F. G. Baum, who advocated this type for such a high head, and also to Mr. Arnold Pfau, of the Allis-Chalmers Co., who designed it.

It is a noteworthy coincidence that Francis brought out this new turbine design in 1849, the same year that Californian streams became the Mecca of gold-seekers throughout the world. During the fifty-nine years that have since elapsed, this turbine has been changed by American manufacturers so as to be more valuable, just as the Sierran streams have become more valuable for their power than for their gold. Today, for medium heads, the turbine threatens to displace the modern successor of the hurdy-gurdy which was first developed in the attempt to harness these very waters.

The wheel is mounted on a horizontal shaft, and has a radial inward flow, and single axial discharge. The characteristic feature of such a reaction turbine is that the wheel-passages are completely filled by the water flowing through them, the pressure varying continuously between the point of admission and discharge. With a submerged turbine, the effective head is increased and the kinetic energy of the discharged water reduced by means of a draft tube or diverging passage. Such a diffuser gradually reduces the velocity of the stream before it passes into the tail water.

This wheel consists essentially of an outside ring supporting stationary curved guide-vanes and an inside runner, on which are mounted moving reversed-curve vanes or buckets. These latter receive the water simultaneously all around the periphery, being completely filled with water flowing under pressure. At the time of entrance it has had a certain direction imparted to it by the guide-vanes. This direction is gradually opposed, and its velocity restricted by the runner-vanes, which are thus caused to revolve.

From the pen-stock the water passes at the bottom of the turbine into the spiral wheel-case, in which it is progressively narrowed in its circuit around the guide-ring. After passing through the runner-vane it is axially discharged from one side of the wheel through a quarter turn pipe into the draft tube. There are two sets of guide-vanes, an outer set of four, and an inner set of twenty-four. These last are pivoted and mounted on a speed ring, which is lever-connected with the governor, by means of which they are opened or closed so that the amount of water admitted is varied with the load. They are close together at low heads, and as the load increases diverge to allow the passage of more water.

The fact that this reaction turbine displaced two impulse units brings up the mooted question of the relative advantages of these two types of machines, the former utilizing both the velocity and pressure of the water, the latter its velocity only. The answer to this question depends upon certain conditions as to head, loads, pipe size, velocity, etc., and also depends upon the designer's ability in interpreting and meeting these conditions.

Only four Francis installations are available on the Pacific Coast with which to institute a comparison with the hundreds of impulse wheels in successful operation. At Snoqualmie Falls the Seattle & Tacoma Power Co. is operating a 10,000-horsepower turbine under a head of 260 feet at a speed of 300 revolutions per minute; in the plant of the Truckee River General Electric Co. is a 3,000-horsepower wheel under 126-feet head; on Bishop Creek, California, is a 2,000-horsepower Francis turbine operat-

ing under a static head of 408 feet, and at Centerville is the 9,700-horsepower unit under a head of 565 feet. The first two have been in operation a little over two years, but the last two mentioned have been running but a few months.

From this limited experience it is evident that with regards to efficiency they are evenly matched, giving about 80 per cent. In the matter of price the turbine wheel is relatively cheaper, say, 12 per cent, and to this must be added the smaller space occupied and the additional tail-water head now utilized by the reaction wheel. In the matter of regulating and governing, the impulse wheel has much the advantage, though as already shown in the special case under discussion, local regulation is here unnecessary.

The problem of regulating the quantity of water supplied to a turbine without causing great loss in efficiency, is one that has been sadly neglected by the designers, whose habit of ordering a governor to furnish a certain number of foot pounds to operate the gate, is not much more successful than would be his ordering a pair of trousers for a man six feet tall and weighing 190 pounds, without having his measure taken by a tailor. This is in contrast to the European practice of designing the governor as an integral part of the installation.

Likewise, in the matter of varying loads, the impulse wheel gives higher efficiency over a wider range, and in inexperienced hands there is also less wear and tear of the impulse wheel. When such does occur it is more easily and quickly repaired than in the turbine. One broken turbine blade ordinarily causes more vibration and damage than a broken impulse bucket. This matter of wear is obviated by proper attention to the water supply, removing silt in settling basins and keeping out twigs by screens and grizzlies.

The relative merits of these two types we are not at this time prepared to discuss. With us the turbine is on trial, and, for medium heads of from 200 to 600 feet, and for large, steady output, requiring little regulation, it is giving eminent satisfaction. It is no more likely to invade the impulse wheel's proper province for heads as high as 2,000 feet than is the latter to be utilized for heads of twenty feet or less. The present difficulty of the control of the machine and of the relief valve will soon be overcome, and we will then have available another necessary factor in solving the integration of efficient hydro-electric power. Neither is a universal panacea—each has its limitations, but is necessary in its proper place. That of the turbine is large output under medium head.

The value of porcelain produced for electrical purposes increased in value from $2,253,061 in 1905 to $2,838,284 in 1906, a gain of 25.97 per cent. This product was reported from nine States in 1906 and composed 9.03 per cent of the pottery total, Trenton, New Jersey, being first, and East Liverpool, Ohio, second.

PERSONAL.

Clem A. Copeland has returned to Los Angeles from San Francisco.

F. C. Finkle is to have charge of the construction of the Edison Electric Company's new Kern River power plant.

A. E. Drendell, of the Drendell Electric Co., of San Francisco, has been in Los Angeles and San Diego during the past week.

Mr. Alexander Henderson, of the American Circular Loom Co., on his return from Honolulu, requested the "Journal" to thank the local electrical fraternity for the many courtesies rendered him and to express his appreciation of their hospitality and good-fellowship. This was inadvertently omitted in our last number.

F. E. Stewart has been appointed San Francisco manager for B. F. Kierulff, Jr., & Co., of Los Angeles, engineers and dealers in electrical equipment and Pacific Coast Agents for Chicago Insulated Wire & Mfg. Co., Waclark Wire Co., Heany Fireproof Wire Co., Hartman Circuit Breaker Co., Lord Electric Co., Sterling Electric Co., American Diesel Engine Co., Franklin Rolling Mill and Foundry Co., and Ideal Electric and Mfg. Co. The local office and warehouse are at 824 Folsom Street.

TRADE CATALOGUES.

Bulletin No. 150A, supplement from the Holtzer-Cabot Electric Co., shows new pattern "O" annunciator for house and elevator use.

H. W. Johns-Manville Co. send an interesting leaflet on asbestos, roll fire-felt, a pliable, indestructible material that is fire-proof, and forms an excellent insulator.

Type "K," direct current motors, are described in Allis-Chalmers Company's Bulletin No. 1057, which also contains illustrations of motor-driven machine tools.

Lighting transformers are described in Allis-Chalmers Company's Bulletin No. 1061, which not only contains a minute description of the transformers, but also information on insulating oil and insulation tests.

The Weston Electrical Instrument Co., of Newark, N. J., send a descriptive folder of the new Weston portable alternating current voltmeters, ammeters and mil-ammeters. These constitute a new group of portable Weston instruments for alternating current measurement. It is claimed that they have no chamber, inductance or working error.

Allis-Chalmers Co.'s Bulletin No. 1512, entitled "Compound Reynolds-Corliss Engines," contains information on the building of compound engines, from the first one known as the famous "Centennial" engine, to those recognized today as embodying in their design and construction the very highest development of the engine builder's art.

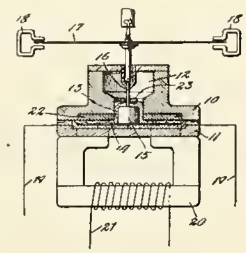
WARNING.

An individual calling himself "Capt. Pearson," of London, has been victimizing engineers throughout the country by a tale of alleged hard luck. He represents himself as an artillery officer and has various stories. The following description of him has been furnished us: Height 5 ft. 9 to 10 in.; weight 140 to 150 pounds; eyes, black or dark brown, shifting nervous; mustache black, small; not well dressed, slovenly; build, spare, light; complexion bloodless, pale, looks rather consumptive; teeth, bad, hair black; age about 40 years. This person has left Philadelphia, and may be expected to turn up in any of the large cities of the United States.

PATENTS

ELECTRIC MERCURY-MOTOR METER. 878,629. Jacob H. Hodde, Springfield, Ill., assignor to Sangamo Electric Company, Springfield, Ill.

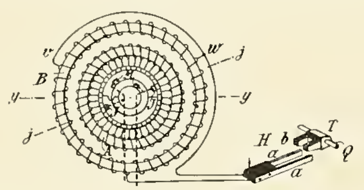
The combination with a body of mercury and a spindle



rotating therein, of a washer of non-amalgamable material loosely surrounding spindle at the point where it enters the body of the mercury, washer being provided with an amalgamated under surface.

SINGLE-PHASE MOTOR. 878,923. James J. Wood, Fort Wayne, Ind.

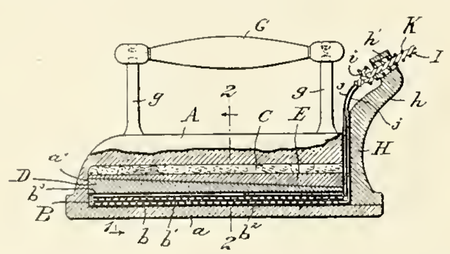
In a single-phase motor, a rotor winding provided with both commutator and collector rings, two sets of brushes adapted to engage said commutator and collector rings respectively, connections from both sets of brushes to an ex-



ternal source of current, means mechanically connected to said brushes for bringing them alternatively into engagement with said commutator and collector rings respectively, and a stator winding short-circuited on itself on a definite line.

ELECTRICALLY-HEATED SAD-IRON. 879,046. Harry Hertzberg and Maurice J. Wohl, New York, N. Y.

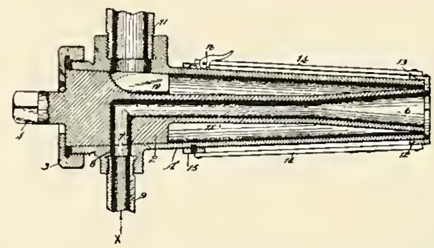
In a device of the class described, a chambered body or mass of metal, an electrical heater therein, and upper and



lower wedges for clamping said heater into close contact with said body or mass of metal, certain of said wedges being spaced and providing air circulation spaces through the chamber of said body or mass.

OIL-BURNER. 878,874. Clark S. Evans, Oakland, Cal.

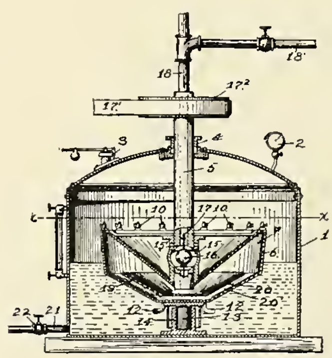
In an oil burner, the combination of a shell open at both ends, shell having a conical bore, a single plug seating in and turnable in the bore, plug having separate oil and



steam ports registerable with corresponding ports in the casing, plug having a longitudinally extending steam passage and shell having a longitudinally extending oil passage concentric with steam passage, plug being turnable to regulate the admission of both the steam and oil.

AIR-COMPRESSOR. 878,579. Lamartine C. Trent, San Francisco, Cal.

An apparatus comprising a pressure tank or cylinder, a receiver rotatably mounted therein, an inlet in receiver for the admission of water, an air supply for admitting air to the in-



terior of the receiver at the point of the admission of the water, outlets in the receiver for the escape of air under pressure, an auxiliary water inlet for receiver connecting with the interior of tank or cylinder and means for imparting rotation to the receiver for centrifugally forcing air and water therefrom under pressure into the pressure tank or cylinder.

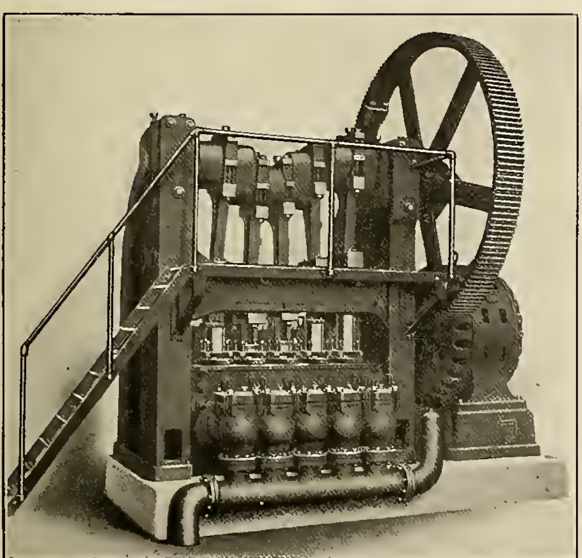
ATTACHMENT-PLUG. 879,723. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill.

An attachment plug for electric lamp sockets comprising an insulating base, a movable lamp contact carried by said base, a ring having a slot formed therein associated with said base, said slot being adapted to engage said lamp contact, said ring being adapted to remove said contact from engagement with lamp socket to permit the plug to be inserted therein without rotating the plug.

INDUSTRIAL

ELECTRIC PUMPING INSTALLATION IN THE ANACONDA COPPER MINES.

An interesting electric pumping installation is being made by the Anaconda Copper Company in its mines at Anaconda, Montana. The pump, which is illustrated herewith, is a 6x12 Aldrich Vertical Quintuplex type made by the Allentown Rolling Mills, Allentown, Pa., and is designed to deliver 425 gallons of water per minute against a head of 1,100 feet. This pump is to be driven by a Westinghouse type "CCL" alternating-current motor of 150-horsepower capacity at 450 revolutions per minute.



MOTOR DRIVEN PUMP.

The duty calls for heavy, substantial construction, and acid-resisting material was required to be used in making the throat and plungers and other parts of the water end, on account of the bad condition of the mine water which is to be handled. The use of five plungers operating from one crank shaft, having connecting rods placed 72 degrees apart, gives a uniform velocity of water in the pipes, thus adding greatly to the efficiency of the outfit.

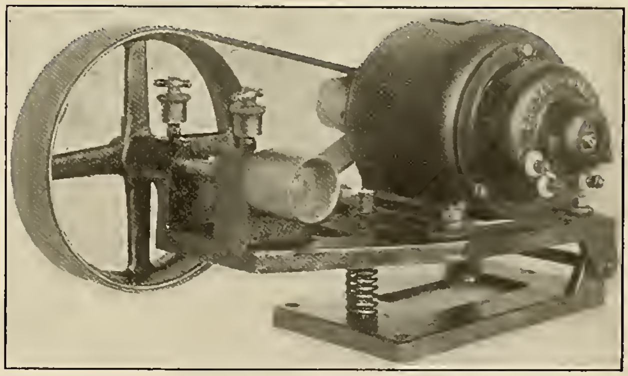
The plungers are single acting and outside packed. It is claimed that, owing to the large size of the throats and valves and the comparatively low water velocity through all the orifices, a high efficiency is obtained. This type of pump is becoming very popular in the Montana copper country by reason of its reliability and high efficiency, both of which are particularly important in mining operations, especially where power is purchased from transmission lines.

COUNTERSHAFT BELT TIGHTENER.

An ingenious and simple device for tightening the driving belt of an electric motor has just been perfected by the Crocker-Wheeler Company and is shown in the accompanying illustration. It consists of a countershaft and a simple and effectual belt tightener. Though designed for the peculiar requirements of linotype machines, it can be used to advantage with any machinery requiring slow speed drive.

The device consists of a cast-iron base, on which are mounted the motor and countershaft. The base is pivoted at one end to a sub-base, and belt tension is produced by means of an adjustable nut at the other end. A spring is provided to support the movable base in case of breaking of the belt. The belt between motor and countershaft is tightened in the usual way, by shifting the motor on the movable base with the aid of an adjusting screw.

It will be readily seen that this device is much more effective than a simple idler. Not only does it keep tension



CROCKER-WHEELER MOTOR.

on the belt, but by the use of the countershaft a great difference between sizes of driving and driven pulleys is avoided, and the belt therefore makes contact with a greater arc of the driving pulley, with consequent absence of slip.

The motor is of the Crocker-Wheeler "L" type, made in sizes from 1-20 to 5 horsepower. Of neat appearance and compact design, it is specially suited for application to small tools, printing presses, pumps, and all kinds of light machinery. Thousands of applications have been made with the Form L motor, which has become a standard machine. By means of simple covers for the openings in the frame, the motor is easily rendered dust and moisture proof, in cases where an open type of motor would be out of the question.

The Haller Sign Works, of Chicago, Ill., write that they will sell the right to manufacture and sell electric signs and letters under their patents in the territory west of the Rocky Mountains.

DEARBORN DRUG AND CHEMICAL WORKS.

Robert F. Carr and several of his associates in the Dearborn Drug & Chemical Works, have purchased the holdings of the estate of the late Wm. H. Edgar, who died two years ago, and at a meeting of the stockholders, followed by a meeting of the directors of the company, the following officers were elected:

Robert F. Carr, president and general manager; George R. Carr, vice-president; Grant W. Spear, vice-president; Wm. B. McVicker, vice-president and Eastern manager; J. D. Purcell, assistant general manager; W. A. Converse, assistant secretary and chemical director; R. R. Browning, assistant treasurer; A. E. Carpenter, superintendent. Mr. C. M. Eddy's holdings were also taken over, he desiring to devote all of his time to his personal business interests.

Robert F. Carr became connected with the Dearborn Company very soon after it was organized, entering the business shortly following his graduation, in chemistry, from the University of Illinois, in '93; for the past ten years he has been vice-president and general manager of the company, and during most of that time, especially the last few years, has been actively in charge of the business and organization.

Mr. George R. Carr has been connected with the company since he graduated from the University of Illinois, in chemistry, in '01. Mr. G. W. Spear, who is a graduate in mechanical engineering, University of Illinois, entered the business in '95. Mr. Wm. B. McVicker has been connected with the company for thirteen years, having during most of that time been at the head of the Eastern department. Mr. W. A. Converse, who was elected to the position of assistant secretary, has been in charge of the laboratories for the past twelve years. J. D. Purcell, the new assistant general manager, has represented the company in the railroad department for five years, having been with the company since 1896. Mr. A. E. Carpenter, superintendent, has had charge of the manufacturing department for many years, and is the oldest employee in the service of the Dearborn Company.

The preparations manufactured by the Dearborn Company for the treatment of boiler waters, both in stationary and railroad service, are most generally used. The scientific methods originated by their laboratories, of treating each water individually, as per requirements, after analysis, has made it possible for Dearborn preparations to give the highest efficiency with all classes of boiler feed supplies.

Catenary trolley suspension on the Syracuse Lake Shore & Northern Railroad is used for direct current operation of cars. This equipment was designed for single phase alternating current at 6,600 volts, but as only 4½ miles have been completed, and as all existing rolling stock is of direct current type, this system is being thus used temporarily. With concrete-supported steel bridges, 300 feet apart, and catenary construction, the cost was $800 per mile more than the standard suspension, with double sets of 35 feet wooden poles, 85 feet apart. The former is much more durable, gives clearer view of right-of-way, and is cheaper in operation.

JAPANESE HYDRO-ELECTRIC PLANT.

The General Electric Company is furnishing complete electrical equipment for a hydro-electric plant in Nagoya, Japan, a city with a population of about 250,000, situated some 300 miles from Yokohama. The main generating station will be built at Yawozo on the Naiko River, where power will be generated at 6,600 volts by four three-phase, 2,500 kilowatt, 60-cycle, 360 revolutions per minute water wheel driven generators. The generator voltage will be stepped up to the line voltage of 60,000 volts by twelve water cooled transformers of 1,000 kilowatt capacity each, and transmitted thirty miles to the main sub-station just outside of the city of Nagoya. Here, the line voltage is to be stepped down to 11,000 volts by nine water cooled transformers of 1,350 kilowatt capacity each, and transmitted underground to the distributing station through triple conductor lead armored cables, the city ordinances prohibiting an overhead transmission of over 3,500 volts.

In the central distributing station the voltage will be stepped down to 3,400 volts by nine water cooled transformers of 1,350 kilowatt capacity each, at which potential it is to be distributed throughout the city by both overhead and underground cables.

It is interesting to note that from the nearest railway station the entire power apparatus for the Yawozo station will have to be transported on specially constructed wagons drawn by oxen.

The Naiko River is normally 40 feet in depth, but in the rainy season the river often rises to 40 and 70 feet above low water mark. This rising characteristic of the river will necessitate the building of a specially designed dam to take care of the high water.

GENERAL ELECTRIC LAMPS.

In order to provide for the very heavy demand for Edison lamps, and to take care of the new developments in Gem, Tantalum and Tungsten lamps, the General Electric Company have in the past year built four new factories at East Boston, Toledo, O., Fort Wayne, Ind., and Newark, N. J. The factory at Toledo is confined to the production of Gem filament lamps only. That of the Newark factory to Tungsten lamps only, and the factories at East Boston and Fort Wayne to the regular carbon filament lamps. In addition, the General Electric Company has erected a new factory building at Harrison, N. J., adjoining the present lamp factory, which is devoted to the production of Tungsten lamps. In addition to these new factories the main factory at Harrison, N. J., continues its large output of carbon and Gem filament lamps. The total productive facilities of the General Electric Company now aggregate sixty million lamps per year, so that they are in excellent position to supply all demands from customers.

The next convention of the National Electric Light Association will be held in Chicago, May 19th to 22nd. The sessions will be held in the Fine Arts Building, with headquarters at the Auditorium Hotel.

SINGLE-PHASE ELECTRIC RAILWAYS.*

M. N. Blakemore.

Much information has appeared from time to time in various technical journals, giving data as to the advances that have been made in the single-phase railway field, but nowhere has there appeared a concise, comprehensive statement of what has actually been accomplished. It is to fill this gap that the writer has been prompted to gather this information together and present it in condensed form. It is interesting to note the rapid strides which this phase to that so common abroad, has been tried, but is not so successful as the pantagraph type of trolley. This is due to the fact that the sliding bow trolley does not respond so readily to the varying heights of wire as does the pantagraph trolley.

Summary.

Total number of Roads	MILEAGE			Total number of Cars	Total number of Locomotives	Total h. p. of motors employed
	Total	In Operation	Under Construction			
28	966.3	691.8	274.5	240	57	137,400

The table is prepared from data secured through the courtesy of the Westinghouse and General Electric Companies, and contains much information regarding the roads in this country equipped with single-phase apparatus. The main features of the table are given in the summary. In the table, the mileage given is simply the length of the road, and does not take into account the fact that some may have two, three or four tracks electrified. If an accurate statement could be made, the mileage would be considerably increased.

DATA ON SINGLE-PHASE ELECTRIC ROADS IN AMERICA

NAME OF ROAD	Length (Miles) of Line Electrified	Equipment					Line Characteristics		Electric Service Started
		Cars		Locomotives		Type of Control Used			
		No.	Motors	No.	Motors		Voltage	Cycles	
Westinghouse									
Indianapolis & Cincinnati Traction Co.	116	25	4-100	0		Unit Switch	3300 550	25 D.C.	Dec., '04
Westmoreland Traction Co.	6.6	4	4-50	0		Hand	1200	25	March, '05
San Francisco, Vallejo, Benecia & Napa Valley Ry. Co.	34	2 8	4-75 4-100	0		Unit Switch	3300	25	June, '05
Atlanta Northern Traction Co.	18.2	8	4-50	0		Hand	2200	25	July, '05
Warren & Jamestown Street Ry. Co.	22.5	6	4-50	0		"	3300	25	Aug., '05
Long Island Railroad Co.	5	6	2-50	0		"	2200	25	Sept., '05
Spokane & Inland Ry. Co.	115	21	4-100	6 8	4-150 4-175	Unit Switch	6600 550	25 D.C.	Nov., '06
Erie Railroad Co.	34	6	4-100	0		"	11000	25	Dec., '06
Fort Wayne & Springfield Street Ry. Co.	21.5	4	4-75	0		"	6600	25	Jan. '07
Pittsburgh & Butler Street Ry. Co.	33	11	4-100	0		"	6600 550	25 D.C.	May, '07
New York, New Haven & Hartford Railroad Co.	22	0		35	4-250	"	11000 600	25 D.C.	July '07
Windsor, Essex & Lake Shore Rapid Railway	28	5	2-100	0		Hand	6600	25	Sept., '07
Grand Trunk Railroad Co. (Sarnia Tunnel)	3.5	0		5	3-240	Unit Control	3300	25	Under Const.
Visalia Electric Ry. Co.	23	4	4-75	1	4-125	"	3300	15	" "
Chicago, Lake Shore & So. Bend Ry. Co.	78	24 4	4-125 2-75	0		Unit Switch Hand	6600 575	25 D.C.	" "
Denver and Interurban Railway Co	46	10	4-125	0		Unit Switch	11000 575	25 D.C.	" "
Hanover & York Street Ry. Co.	20	5	4-75	0		"	6600 575	25 D.C.	" "
Shore Line Electric Ry. Co.	12	4	4-75	0		"	6600	25	" "
Maryland Electric Ry. Co.	24	9	4-100	0		"	6600	25	" "
General Electric									
Bloomington, Pontiac & Joliet Ry. Co.	19	2	4-75	0		K	3300	25	In Operation
Toledo & Chicago Ry. Co.	43	7	4-75	0		K	3300 575	25 D.C.	" "
Milwaukee Electric Ry. & Light Co.	59	11	4-75	0		M	3300 575	25 D.C.	" "
Central Illinois Construction Co.	80	20	4-75	1	4-150	M	3300 575	25 D.C.	" "
Richmond & Chesapeake Bay Ry. Co.	15	4	4-125	0		M	6600	25	" "
Anderson Traction Co.	20	3	4-75			K	3300 575	25 D.C.	" "
Washington, Baltimore & Annapolis Ry. Co.	60	21	4-125	0		M	6600 575	25 D.C.	Under Const.
New York, New Haven & Hartford R. R. Co.	8	4 2	2-125 4-125			M	11000	25	" "
Shawinigan Railway Co.		0		1	4-150	M	6600 600	30-15 D.C.	" "

of the art has taken since it first appeared commercially in 1903. It may cause some surprise when it is stated that one company alone has already filled orders for more than fifty locomotives, all of which were designed for operation on single-phase alternating current, while of this number considerably more than half were adapted for both alternating and direct current.

In addition to the locomotives indicated in the table, several other special ones have been built for operation on alternating current. Of these might be mentioned the 135-ton single-phase locomotive for the Westinghouse Inter-Works Railway, and the 70-ton 15-cycle alternating-current locomotive which is now being tested by the Pennsylvania Railroad.

All of the installations mentioned are operated from a single catenary trolley, with the exception of the New Haven road, which uses the double catenary line construction. The pantagraph trolley is almost exclusively used in this country, although a sliding bow trolley, somewhat similar

*The Electric Journal.

Consul Thomas H. Norton, of Chemnitz, reports that by the Slaby-Arco system of wireless telegraphy, over 1,000 words were recently telegraphed from the trial station of the company at Nauen, near Berlin, to the Austrian military station for wireless telegraphy at Korneuberg, near Vienna, a distance of about 372 miles. He adds that this is the record result thus far in the use of the system for overland transmission.

NEWS NOTES

TRANSMISSION.

Petaluma, Cal.—The California Gas & Electric Corporation will commence on a $2,000 electric power plant on the Whitney Block in this city.

Bakersfield, Cal.—It is learned that the next Edison Electric Company's power plant on the Kern River is to be commenced in August. The new power plant will be built in the canyon above Kernville, and will be larger than the present plant.

Oroville, Cal.—The Northern California Mining Company is perfecting plans for two power plants, which will utilize the water of Fall River, a branch of the middle fork of the Feather River, and will be located in the Mooretown district, about 40 miles above Oroville. At one place, a fall of 1,000 feet can be secured, with a minimum flow of 2,000 miners' inches of water. According to the United States Geographical Survey, the falls of Fall River have a drop of 475 feet.

Imperial, Cal.—The closing of the gates of the Holton Power Company's canal, in obedience to restraining orders issued by Judge Wellborn, resulted in the cutting off of electricity from all parts of the valley. Chief Engineer Herrmann, of the California Development Company, believes the result of the restraining order will be the earlier building of a dam in the Alamo River, and a conduit system to take water from below the power house for use in irrigation. The estimated cost of this work is $225,000. The worst inconvenience will be that of lights. At Brawley, preparations are being made to install gasoline engines for the domestic water supply. The Southern Pacific Company has ordered a steam engine rushed to Imperial to pump water into its tanks.

Chihuahua, Mexico.—The Kansas City, Mexico and Orient Railroad Company is planning for the construction of an immense hydro-electric power plant on the El Fuerte River, in Sinaloa, not far west of the Chihuahua State line. The plan is to build a plant that will develop 5,000 or 6,000 horsepower by utilizing the water power of that stream, and use the electric power in the construction of the Orient Railroad as it proceeds eastward through the worst part of the Sierra Madre Mountains, and sell it to the mines in that section. A. M. Nelson, the engineer and superintendent of construction of the Orient in Mexico, is now on the El Fuerte River making the surveys necessary to making a report on the advisability of the plan. The company is said to have bought up what is known as the O'Gorman concession for water power on that river. It is claimed that 10,000 horsepower can be had there.

INCORPORATIONS.

Salinas, Cal.—The American Petroleum Company has been incorporated by Los Angeles men with a capital stock of $1,000,000.

San Francisco, Cal.—The Sparks Mineral Water Company has been incorporated, with a capital stock of $10,000, by L. W. Martin, P. D. La Montanya and W. H. Fisher.

Bakersfield, Cal.—The Ubertas Oil Company has been incorporated by C. L. Metzger, Fritz Boehmer, A. B. Fowler, H. M. Whitely and J. L. Gould. The capital stock is $100,000.

Bakersfield, Cal.—Articles of incorporation have been filed by the State Oil Company. The capital stock is $100,000, and the directors are D. J. Graham, E. W. Rice and W. E. Colby.

Fresno, Cal.—H. E. Barnum, E. J. Boust, H. C. McKay and S. L. Hogue have filed articles of incorporation for the Fresno-Midway Land & Oil Company, with a capital stock of $25,000.

San Francisco, Cal.—The Enterprise Electric Works has been incorporated, with a capital stock of $24,000, by Frank Jones, G. E. Roe, Bertha Roe and Mary E. Jones. Place of business is San Francisco.

Ukiah, Cal.—Articles of incorporation have been filed by the Willits Oil Development Company, with a capital stock of $50,000. The incorporators are A. J. Muri, W. Seyfarth, Bren Schow, E. F. De Camp and Chas. Tuck.

San Francisco, Cal.—Articles of incorporation have been filed by the Sesnon Oil Company, with a capital stock of $100,000. The incorporators are W. E. Knowles, W. T. Sesnon and J. J. Fagan. Place of business is San Francisco.

Oakland, Cal.—Articles of incorporation have been filed by the San Francisco & Bay Counties Railway, which plans to operate an electric railroad between Oakland and San Jose in opposition to the Southern Pacific. F. M. Smith, F. C. Havens, E. A. Heron, George E. Pratt and Dennis Searles are named as directors of the new railway. Within ninety days the actual laying of tracks will commence. The terminus of the line will be at the Key Route pier by the way of Berkeley. The proposed electric line will commence at Berkeley and skirt the Berkeley hills, touching at Piedmont. The company is capitalized at $250,000, of which $70,000 has been subscribed.

TELEPHONE AND TELEGRAPH.

Elko, Nev.—Manager Thomas, who is superintending the construction of a telephone line between Salt Lake City and Elko, to connect the Utah cities with those of the Pacific Coast, reports that the work is in progress this side of the Utah-Nevada State line and the line is following the route of the Western Pacific Railway.

Los Angeles, Cal.—The Home Telephone Company, which five years ago obtained a franchise under the Broughton act, then newly passed by the Legislature, has paid into the city treasury the sum of $14,588.71, representing 2 per cent of its gross earnings during the past year. The sum is the largest received by the city under the terms of the act.

THE
Journal of Electricity, Power and Gas

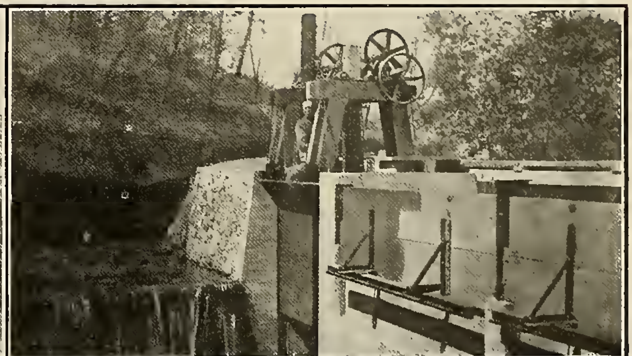
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MARCH 7, 1908 No. 10

CENTERVILLE CANAL.

As indicated in last week's paper descriptive of the high-head Francis turbine at the Centerville plant of the California Gas and Electric Corporation, great care is necessary to keep out silt, leaves and twigs from the pipe line. These clog the gates and wear the vanes. Consequently the necessity for careful ditch and flume line construction is evident.

CENTERVILLE FLUME.



SETTLING BASIN DISCHARGE, SHOWING CONSTRUCTION OF FLUSH BOARDS

FOREBAY DURING CONSTRUCTION.

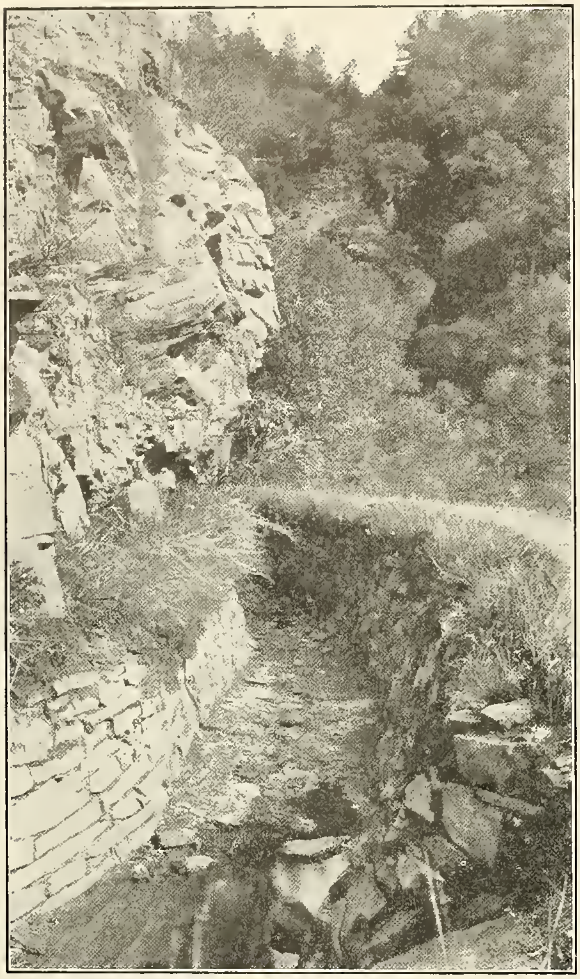
SPILLWAY.

As stated in that paper, the Centerville plant makes a second use of the water that has already developed 14,000 kilowatts at the De Sabla powerhouse, about eight miles above. About a quarter of a mile below the De Sabla powerhouse, a cyclopean concrete dam, 15 feet high, 3 feet wide on the crest, 90 feet long, and arched up stream, diverts the water from Butte Creek into the canal intake. The reconstructed remains of an old log crib dam above the new dam site were used as a wing dam to allow excavation to the rock bed. After the forms had been built, the concrete was wheeled and dumped into the place, large boulders were placed by hand throughout the mass at least three inches apart and the same distance from the forms. Wherever there was enough space between the rock, spalls were used. The concrete was poured wet, and each large rock was worked into place to secure a good bed. A hard, smooth surface was given the crest of the dam by a rich grout.

Wooden head gates, operated as shown in the accompanying picture, regulate the flow of water into the canal. The gates are supported by a concrete wall, which raises the operating device above extreme high water and serves as a protection to the canal approach during high water and consequent debris. The canal approach at the bottom has a rapid grade from the head to the side gates, where it is four feet below the canal grade; this allows the sand and gravel to settle before discharge through the side gate. Once a day is usually often enough for this, but during stormy weather it is done twice each day. The four-foot rise from the bottom of the canal grade is vertical and curved from the back wall to the lower side of the gate to prevent turbulance and make the velocity of approach effective for discharging the sand and gravel through the sluice gates.

Ditch work forms 80 per cent of the canal, there being but 1.6 miles of flume in its length of 8.3 miles. It had originally been built to supply 45 second feet to mines below. Contrary to the usual practice, this ditch had been dug on a uniform grade of 1.28 feet per thousand feet. During years of disuse it had been overgrown with brush and broken down in places, but it formed an excellent basis for the new line. In rebuilding, its capacity was increased to 175 second feet,

with an average width of 11½ feet, and an average depth of 5½ feet, with the same grade. The side slopes varied with the character of the material through which the ditch was

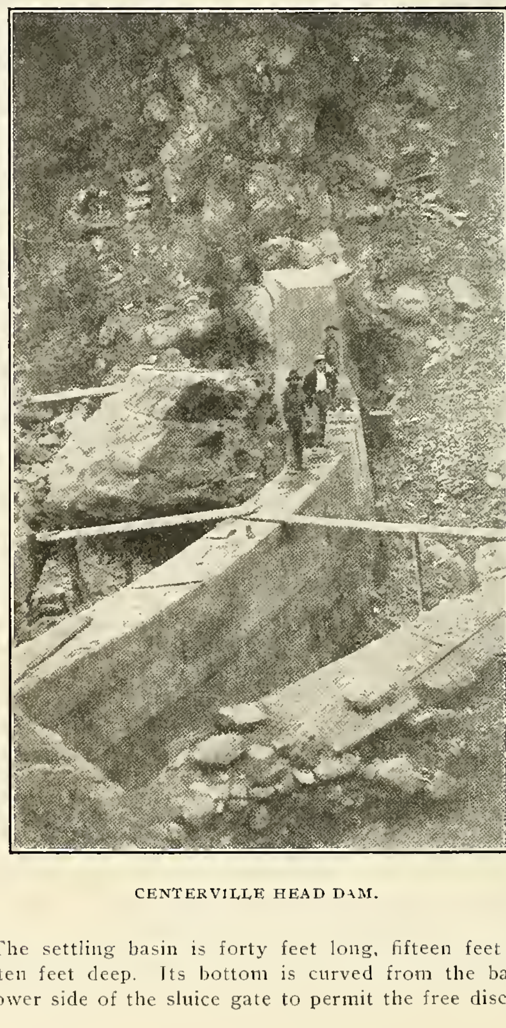


CANAL PRIOR TO CONSTRUCTION.

running, being determined in the field. A rock wall was built wherever rock was plentiful and the bank was loose and porous; plank side lining was used only where no other rock was convenient. Clay puddle was placed between the berme and the lining to prevent saturation and sloughing of the outer bank. The photograph shows the original and final section of the ditch.

In the flume work, heart sugar pine was used for the battens and box boards; belting, stringers and bent work being of heart spruce. The framing was done at the head of the canal and the lumber floated down and distributed before construction commenced, the ditch and flume work being carried on simultaneously. A 6-inch Fox dado head and 16-inch cut-off saw run by an electric motor did the framing. The dado would cut a gain ¾ inch deep and 6 inches wide quicker, cleaner and better than could be done by hand. After digging to a solid foundation, 6-inch by 8-inch cedar blocks were used as mudsills, upon which were placed the batten posts. The cedar resists decay better than the spruce and is easily renewed. The accompanying photograph shows the type of construction generally employed. Sixteen feet on either end of the flume were constructed on the ditch tangent, thus throwing all of the curve into the flume proper. This prevents the disturbance at the ends of the flumes, which was also guarded against by goring the end boxes and finishing off with four feet of rock wall with a warped surface. These precautions eliminate entrance and exit losses. Deep sand boxes with waste gates were placed at intervals along the canal, which catch silt and turn the water out of the canal in case of trouble from slides or other causes. At the lower end a grizzly was placed in the canal at an angle of 30 degrees, the submerged end being supported one foot above the ditch bottom with a heavy angle. All leaves, limbs and other large, light debris are carried up the 30-degree slope of the grizzly by the velocity of the water. This material is raked off daily by the ditch attendant.

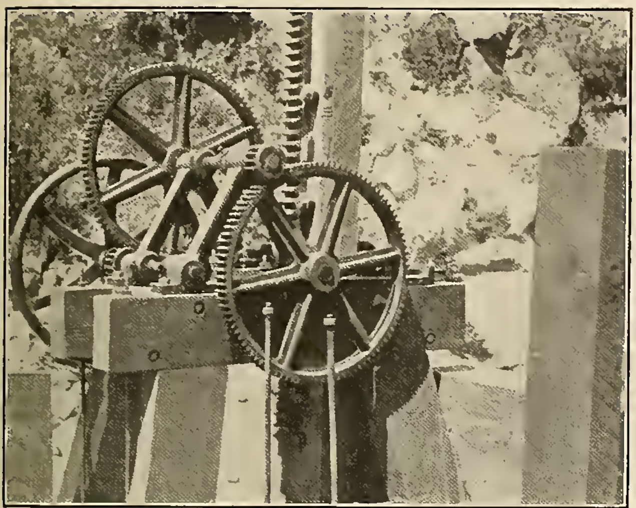
Between the grizzly and the forebay is a large settling basin equipped with deep waste gates and two sets of flash boards ten feet wide and two feet high. The latter trip automatically if the water raises above the normal. In the picture of these flash boards, it will be seen that they are free to turn about a horizontal axis, being normally kept in position by the weight of a rail on the lower side. As the water rises above normal its pressure counteracts this and trips the boards so as to allow the water to flow out above and below it, When the pressure is removed, it swings back into place again. This removes the necessity of constructing a very wide-crested shallow weir, and allows close regulation of head water level. Mr. James H. Wise, assistant hydraulic engineer for the California Gas and Electric Corporation designed and constructed the entire works.



CENTERVILLE HEAD DAM.

The settling basin is forty feet long, fifteen feet wide, and ten feet deep. Its bottom is curved from the back to the lower side of the sluice gate to permit the free discharge

of the silt. This is drawn off from below as a thick sludge until the water runs clear. The grizzly and settling basin, supplemented by the various sand boxes, remove a large



GATE MECHANISM.

amount of material daily, instead of allowing it either to pass into the pipe line or accumulate in large settling basins without frequent discharge.

A regulating reservoir could not be built at the head of the pipe line because of the steep side-hill slopes at the lower end of the canal, consequently a reinforced concrete forebay was built. As shown under construction in the view, it is 25 feet long, 18 feet wide and 20 feet deep, with six-inch walls. The reinforcement consisted of round rods. The three pipe intakes were separated by two vertical walls, which, together with the controlling gates, permit any one of the pipes to be emptied while the others are supplying water.

As already shown in the preceding article, two 400-kilowatt impulse units were removed before the new 5,500-kilowatt turbine unit was installed. In addition to the two 24-inch pipes, a third pipe line, 36 inches and 42 inches in diameter, was put in, the three pipes being connected together at the powerhouse by means of a multiple casting, a "Y" being placed in one of the 24-inch pipes for the 900-kilowatt water-wheel connection. The new line is of riveted steel throughout, 2,566 feet long, of which 675 feet is 36 inches in diameter, and 1,891 feet is 42 inches in diameter. The pipe is made up of cylindrical inside and outside courses and the diameters given are the inside diameters of the inside courses. The longitudinal seams are double-riveted lap-joints of about 70 per cent efficiency; the transverse seams are single riveted. A slip joint is provided near the forebay, which allows of expansion and contraction of the pipe line.

The pipe was furnished and laid by Schaw-Batcher & Company, of Sacramento, being made in their shop in three-course sections twenty-three feet in length, shipped to Chico by rail, and hauled to Centerville on wagons. Pneumatic tools were used for all field work, such as reaming, riveting, caulking and holding on. The pipe is supported on concrete piers at intervals and securely anchored with 1½-inch round iron rods. Six-inch air valves were placed at the critical points.

CENTERVILLE HYDRO-ELECTRIC POWER INSTALLATION*

By H. HOMBERGER.

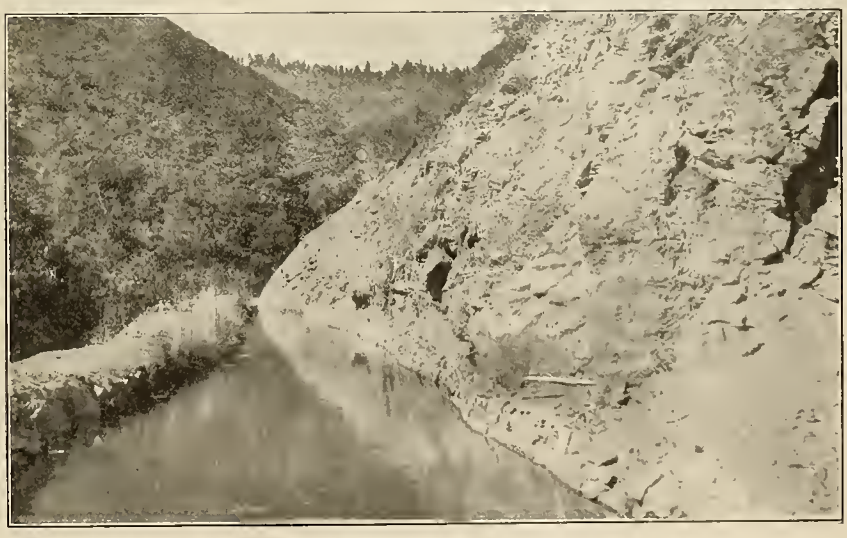
Whether under certain given conditions, viz., head, character of load, length of pipe line, and velocity of flow in the latter, an impulse wheel or a turbine is more advantageous, is at present still an open question. In Europe, low-head plants are installed in preference to high-head developments, because in thickly settled countries it is difficult and costly to acquire high-head water rights, which, to a large extent, holds true in the northeastern part of the United States. Therefore, the low-head water-power machine in Europe has reached a higher state of perfection, and designers and users are more in favor of it because more familiar with that type of hydraulic prime mover.

On the Pacific Coast, where high-head water powers can be obtained easily and cheaply, where the water supply is limited, and where the transportation of great bulk is expensive, high-head installations are preferable; and with the exacting requirements of hydro-electric power generation and transmission, the crude and inefficient hurdy-gurdy of the early miners has, in the form of the modern tangential water-wheel, reached a very high point of perfection.

The most important points, and at the same time the most delicate, with any water-power machine are efficiency and regulation; and in order to pass upon a certain machine as a new departure and eminently successful, these points deserve first consideration. Definite efficiency tests have not been made on the Centerville turbine, but Mr. Wise states that the efficiency will be above 80 per cent, as indicated by preliminary tests. This is nothing extraordinary, as 83 per cent efficiency can be obtained easily with impulse wheels under the conditions as stated. The guaranteed efficiencies were 80 per cent at full load, 82 per cent at three-quarter load, and 77 per cent at half load. If the turbine should run under a heavily fluctuating load, the average efficiency must be decidedly lower, as Mr. Wise stated, with a closing time of five seconds, that it took the relief valve 30 seconds to close. The relief valve having the same vent as the turbine, this must necessarily result in a considerable waste of water.

Fortunately for the turbine, such conditions do not exist in the Centerville plant. The turbine is expected to run under full load all the time, and the regulation is taken care

*Discussion of paper read by Mr. James H. Wise, at the bi-monthly meeting of the San Francisco Assocation of the American Society of Civil Engineers, February 21, 1908.



RECONSTRUCTED CANAL.

of in some other plant by impulse wheels, where a storage reservoir is available, and, incidentally, where the most efficient operators are located.

For this reason, probably, the speaker of the evening has not dwelt on the regulation performance of the turbine; the relief valve apparently was tested as a safety device only, and not as one of the elements of the regulating and governing mechanism. It was evidently satisfactory to see that no trouble occurred when the entire load was dropped suddenly. With a frequently and heavily varying load, and a velocity of some 12 feet per second in the supply pipes, as the conditions actually are at Centerville, no satisfactory regulation could possibly be obtained with this turbine.

Mr. Wise stated that for large units under heads from 200 to 600 feet, a Francis turbine was cheaper than an impulse wheel, a higher turning speed could be obtained, and the application of a draft tube resulted in a better utilization of the available head. I wish to somewhat modify these statements.

The purchase price alone of the bare turbine is no criterion of the ultimate expense to the user. Sales prices are not always governed entirely by the actual manufacturing cost of a machine. In order to give good regulation for varying loads, the pipe line must be considerably larger in diameter for a turbine than for an impulse wheel under equal conditions; and last, but not least, the maintenance expense must not be overlooked. This turbine has been running less than four months, and under extremely favorable load conditions, but the elaborate protections necessary to guard the turbine against wear of the working parts permit a direct conclusion as to how undesirable the replacing of these parts would be. With an impulse wheel, the only wear, even if the water is carrying much detritus, occurs at the nozzle tip, needle, and buckets, and the latter suffer very little, as experience has shown. The replacing of these parts is very simple and quickly accomplished. Should by accident a bucket break, a few hours would suffice to replace it, and it costs but little to carry a few spare buckets in stock. If a vane of a turbine should break out, even if the fragments found their way through the draft-tube into the tailwater without doing damage to the wickets, the turbine runner would be unbalanced, and would have to be replaced. A spare runner is not only very costly, but in order to put it in, the entire machine has to be dismantled, and a shut-down is necessary. The same holds good for the guide vanes and wicket gates, the wearing down of which results in serious loss of efficiency.

The higher turning speed which can be obtained with a Francis turbine, and which cheapens the installation cost, is also to be taken "cum grano salis." There is a dividing line where generators cease to be cheaper as the speed increases, and the curve of production cost goes up again. With reference to the highest permissible speed of an impulse wheel, Mr. Wise apparently is not familiar with the progress that has been made in that respect during the last two or three years. To obtain 10,000 horsepower under 565-foot head, or even under 555-foot head—discarding ten feet of draft head of the Centerville turbine, considering these ten feet the difference between highest and lowest tailwater level—a speed of 400 revolutions per minute could be readily obtained without putting several wheels on the shaft and using two or three nozzles to each wheel. With the most modern design of vertical-shaft, multiple-jet impulse wheel, turning speeds can be obtained which give all that can be desired in low cost of first installation, and the high-pressure step bearings, which seemed to be objectionable, have successfully passed the experimental stage.

Such units of large capacities have been successfully installed in Mexico and Brazil by the manufacturer who is in reality responsible for the Centerville turbine.

Under 550-foot head, such vertical units would not take a bit more room in the powerhouse than a horizontal or vertical Francis turbine. This, however, was of secondary importance at Centerville, as the powerhouse was already provided, and only height had to be added.

Draft tubes are no monopoly of the turbine. They can be used as diffusers for impulse wheels also. It is the question, however, whether it pays to go to the trouble, loss, and expense caused by stuffing boxes, air-tight housings and foundations, to gain one or two per cent in power, which is only actually gained during the period of low tailwater, and which is materially cut down with fractional loads. If it can be shown that an impulse wheel under 555-foot head gives a 3 per cent better efficiency than a turbine with 10 feet additional draft head, then the advantage of the draft-tube claimed for the turbine is offset.

In summing up, I wish to say that to justly compare the two types of machines, two cases must be selected where both work under the same conditions—all details and service conditions must be considered—and I believe I am safe in saying that under a 600-foot head, and even for 10,000 horsepower, the impulse wheel is today the more satisfactory machine, if properly designed and built. To draw the conclusion from this particular turbine, with the easy conditions of load and regulation under which it has been working for four months, that a 10,000-horsepower reaction turbine is more desirable than an impulse wheel under a 600-foot head, I should at least call premature.

CHECKING DRAWINGS.

M. R. Kavanaugh, of Detroit, Mich., calls our attention to the necessity of carefully checking all drawings in order to correct errors and expedite work in the draughting room. During his extensive experience as checker he has observed that many mistakes are caused by carelessness. The best draughtsmen at times lapse so as to make foolish errors. Failure to comprehend the work that the mechanism or tool is desired to perform, and also lack of care in pre-determining the amount of paper space available, result in the loss of many hours' work.

The men who have to be watched the closest are those with technical training and a consequent wide variety of ideas, but lacking practical experience. The best results are obtained by one man checking for such a number of draughtsmen as he can conveniently handle thoroughly. In a short time he will become familiar with each man's work, learning where he is most likely to fall down, when it will be very unlikely for any grave error to pass unnoticed.

To facilitate the work and be sure that the drawings are thoroughly checked I use a regular form of procedure which I give below:

1. Either know or ascertain definitely what the mechanism or tool is desired to do, i. e., what is wanted.

2. Check for interferences, meaning also checking for correct fits and ease of operation. Be sure ample clearance is allowed.

3. See that the drawing is correctly made as regards projections, and that all views necessary and no more are shown. Be sure that all dimensions are on the drawing and that no figures will have to be indirectly obtained by the shop.

4. Check all dimensions by scaling, and when necessary, by calculation. This includes checking over all and center to center distances from known data by calculation.

5. Be sure that all parts are of the proper material and of sufficient strength, and proper finish, and that all parts are called for and dimensioned correctly.

6. Utilize standard parts, and standard screws, bolts, nuts, etc., wherever possible.

7. Check up pattern and symbol numbers. Have drawing conform to the standard system in regard to size, style, and general execution.

ELECTRIFICATION OF RAILWAYS.

By Dr. Gisbert Kapp.

(Continued.)

The impossibility of racing on a down grade is a valuable property of the three-phase system, but the necessity to take up gradients at full speed may be inconvenient because putting too heavy a strain on the plant. There is, of course, no absolute necessity of working the motor always at full speed; we can run it permanently in the starting condition when the slower speed is attained by the insertion of inductionless resistance into the rotor circuit, but such an expedient would be very wasteful, and there would be some difficulty in dissipating the heat generated in these resistances. A method had therefore to be found which would allow three-phase motors to be used at different speeds without wasting energy in resistances. Two such methods have been put into practice. The one consists in using a winding for stator and rotor which allows an alteration in the number of poles. The speed of the motor being inversely proportional to the number of poles, it is obvious that we can run at half speed if we double the number of poles. This may be done by a system of winding in connection with a controller which permits every alternate coil to be reversed. Such an arrangement, designed by Messrs. Brown, Boveri & Co., is used in their latest Simplon locomotives.

Another method of changing speed without wasting power is the use of what is known as "cascade working." This method has been brought to great perfection by Messrs. Ganz & Co., who have used it first on the motor coaches for the Valtellina line five years ago. Each coach runs on two four-wheel trucks, and each of the two axles is direct driven by a motor surrounding it. The rotor is not keyed on the running axle, but on a quill with sufficient clearance to allow for the play of the springs. The motor is suspended from the floor of the coach, and the connection between its rotor and the driving axle is by means of flexible links. Of the two motors on each truck, one is wound for 3,000 volts and the other for 300 volts. The latter is the cascade motor. It receives current from the rotor of the high-pressure motor when starting, or, when running up hill, the motors are coupled, and both are contributing about equal shares of tractive force. The speed is halved. When running on the level the cascade motor is cut out and runs idle, whilst the high-pressure motor is doing all the work at full speed. In this case the starting resistance is by the action of the controller detached from the cascade motor and placed in direct connection with the rotor of the working motor. The transition from half to full speed is thus made gradually. In another arrangement of cascade working the two motors are placed into the same housing and the rotors are permanently connected, so that only one set of slip-rings is required. If the switch is placed to the right, the working is in cascade; if to the left only, the high-pressure motor is giving power.

In both arrangements here described the speed can only be halved, since the cascade motor has the same number of poles as the high-pressure motor. If more than two speeds are required, this can be accomplished by giving the two motors different numbers of poles. Thus, if two motors are used, and one has eight and the other twelve poles, we can get three speeds, which are in the ratio 1/8, 1/12, 1/20. But in this case both would have to be high-pressure motors, since either must be capable of taking the supply direct from the trolley. Since the rotor of the first motor cannot conveniently be wound for high pressure, a step-up transformer would have to be inserted when working cascade, and to avoid this complication Koloman von Kando has devised an ingenious way of winding the stator of the cascade motor so that it may be either supplied at low voltage when working cascade or at high voltage when working direct. In this device each phase has three windings, which are placed in parallel and delta connected when working cascade, and are placed in series and star connected when working direct. The leads are brought out through the case at the top. Corresponding to the three speeds the switch has three positions, and the position taken up depends on which of the three cylinders receives air from a reservoir under pressure which is also used for working all the other regulating appliances and the brakes. It should be noted that in this, and, in fact, in most motors made by Ganz & Co. for main-line working, the slip-rings are fitted outside of the crank so as to utilize the whole of the space between the bearings for the motor itself. In some cases it may be desirable to build locomotives for four standard speeds, and this may be done by using "double cascade." Here the main motor has four poles, and if used alone will give a speed of 50 miles per hour. By combining it with the two cascade motors of two and six poles respectively, a speed of 16.7 miles per hour can be had; by using the main motor with the six-pole cascade motor the speed is 20 miles per hour, and if used with the two-pole cascade motor it is 33.5 miles per hour.

It is interesting to compare the weights of the three types of motors—namely, the continuous-current, the single-phase, and the three-phase. In construction the single-phase resembles the continuous-current motor, the only difference being that its field must be laminated, and that a compensating winding must be added to reduce self-inductance. Since the supply of power is pulsating, the torque for equal weight and magnetization can only be —— of the torque of the continuous-current motor—that is to say, the single-phase motor—especially as its power factor can never be unity, must be 40 to 50 per cent heavier than an equally powerful continuous-current motor. In point of bulk and weight the three-phase motor has a great advantage. For equal armature loading (by which I mean ampere turns per unit length of rotor circumference) the torque is about the same as that of a continuous-current motor. Theoretically it should be 16 per cent greater, but as the power factor (although better than that of a single-phase motor) can never be unity, the advantage of these 16 per cent is lost, but the assumption of equal loading is not correct. In the continuous-current motor, the ampere wires on the armature are only one-half to three-eighths of the field. It is true that by the introduction of commutating poles the disproportion may be somewhat reduced, but the gain is small since, owing to saturation of armature teeth, the distortion of the main field is accompanied by a reduction of useful flux, so that after a certain point is reached the torque does not increase by loading the armature further. In the three-phase motor the load on the rotor is always nearly equal to that on the stator; there is no distortion of the field, and the torque is only limited by the heat capacity of the wires. For this reason three-phase motors are lighter than continuous-current motors of equal power and tractive effort. Their over-all dimensions are less because the slip-rings may be put outside the bearings, whilst in a continuous-current motor the equivalent part—namely, the commutator—must be inside the motor case. Mr. Valatin has introduced the conception of "weight factor," which is a number obtained by dividing the product of speed and weight by the horsepower. Taking, on this basis, the weight factor of a continuous-current motor as 100, the weight factor of a corresponding single-phase motor comes to about 140, and that of a three-phase motor to 60.

Italy.—To the Italian Government belongs the distinction of having from the first realized the enormous advantage electric railway service has for that country. The Milan-Ponto Cerese and, shortly after, the Valtellina lines, were built under Government sanction, and with the intention of being eventually taken over by the Government when the transfer of the steam roads to the State should take place. The experience gained on both these lines has been so favorable that the Italian Government has decided to electrify some other lines at once, and it may be expected that this process will go on steadily, so that eventually all the Italian lines will be worked electrically. For a country which has no coal but plenty of water power, this is obviously a sound policy. There was another circumstance which prompted the Government to set aside a considerable sum (nearly three million pounds) in its last budget for electrification. The whole of the coal used for industrial purposes in Milan and other centers in Lombardy comes by sea via Genoa. The railway lines from Genoa to Milan climb the steep slope of the Apennines north of San Pirredarena, and owing to the heavy gradients only short trains can be dispatched. In addition to the coal traffic there is a large goods traffic for Switzerland and Germany passing over the same metals, so that at times the lines are very congested, and last winter Milan was on the brink of a coal famine. With electric traction the capacity of the existing lines will be nearly trebled, so that the supply of coal to the vast industry of Milan and of Lombardy generally will be assured. On the proposal of the Government the Italian Parliament voted in the last session 1.52 million pounds for power stations, sub-stations, and line equipment, and 1.28 millions for electric locomotives, the intention being to retain the existing passenger and goods rolling-stock and simply change the steam locomotives for electric locomotives. The present program comprises the electrification of 11 main lines, of which two are in Upper Italy, one in Central, and one in Southern Italy. The total mileage is 247, and the total length of track 337 miles. The system throughout is three-phase current, with 3,000 volts on the trolley wires at 15 frequency. The pressure on the feeders is 13,000, 20,000, and 25,000 volts, according to distance, and the sub-station will be fitted with four transformers of 750 kilowatts, of which three connected in delta will supply the line, whilst the fourth is spare. The locomotives will weigh 60 tons, and have five driving axles. They will be fitted with two 1,000-horsepower three-phase motors. The engineers of the Italian Government are evidently strong believers in the three-phase system, which is probably the result of the very satisfactory working of the line which Messrs. Ganz & Co. have electrified in the Valtellina five years ago. This line has a total mileage of 67, and presents a maximum of difficulties. Of the section Lecco-Colico, 33 per cent is tunnel, there are curves of 1,000 feet radius (on switchings and crossings only 500 feet), and there are gradients up to 20 per 1,000. The pressure in the feeders is 20,000 volts, and that in the trolley wires is 3,000 volts. The rails act as one of the conductors. Although the opponents of the three-phase system have prophesied all sorts of trouble with the two overhead conductors, there has been none, and the officials are so satisfied with the system that a proposal is now being considered to change the continuous-current equipment on the Milan-Gallerate-Ponte Caresio line for three-phase equipment. This must not be taken as an adverse criticism on the oldest electric main line in Italy. The line is working very satisfactorily. Since its electrification the number of trains has been quadrupled (the trains being shorter and more frequent), and the number of passengers carried is two and one-half times what it was in steam days. Still, the Italian engineers seem to think that the line could do better still if converted to the three-phase system.

(To be continued.)

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CABLES, ARMORED.

Sterling, flexible armored cable (single wire or multiple conductors). Approved January 20, 1908. Manufactured by

Safety-Armorite Conduit Co., Bailey-Farrell Bldg., Pittsburg, Pa.

CONDUIT BOXES, FLOOR OUTLET.

"Simplex" Floor Boxes, Cat. Nos. 3000, 3000A, 3000B, and adjustable types, Nos. 4000, 4000A and 4000B. Approved Jan. 29, 1908. Manufactured by

Stanley & Patterson, 23 Murray St., New York City.

CONDUIT, UNLINED.

Sterling flexible steel conduit. Approved January 20, 1908. Manufactured by

Safety Armorite Conduit Co., Bailey-Farrell Bldg., Philadelphia, Pa.

FLEXIBLE CORD, PENDANT.

Marking: Brown thread, cabled with copper strand. Approved January 29, 1908. Manufactured by

Standard Underground Cable Co., Pittsburg, Pa.

GROUND CLAMPS.

"D. & D." ground connection clamp. A copper band looped through a ring in special bolt and secured by nut on this bolt. Approved January 29, 1908. Manufactured by

Bernard J. Dever, 1931 Wolf St., Philadelphia, Pa.

SWITCHES, SURFACE SNAP.

Push and Pull Type, 125 volts, single pole, Cat. No. 917, 15A., No. 918, 25A.; double pole, Cat. No. 992, 10A., No. 841, 15A., and 842, 25A. Approved January 29, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

WIRES, RUBBER COVERED.

Marking: Green and black threads crossing in braid. Approved February 1, 1908. Manufactured by

Atlantic Insulated Wire & Cable Co., 120 Liberty St., New York, and Stamford, Conn.

ATTACHMENT PLUGS, FUSELESS.

"Bryant" 3A., 250V. Edison types. Porcelain, brass cap, Cat. No. 1948; Composition, Cat. No. 345. Approved February 3, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

CABINETS.

"Wurdack." Built up on formed steel cabinets, with or without slate or asbestos gutters, steel or wood fronts, with or without glass panel in door. Approved January 18, 1908. Manufactured by

Wm. Wurdack Elec. Mfg. Co., 19 S. Eleventh St., St. Louis, Mo.

CONDUIT OUTLET PLATE.

"Fancleve" Cat. Nos. 601-605, inclusive; for knob and tube work. Cat. No. 700 for flexible armored cable. Approved January 15, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

CUTOUT BASES, PLUG FUSE.

Porcelain base, all types, O-30A., 250V. Approved February 5, 1908. Manufactured by

Empire Electric Mfg. Co., Plainville, Conn.

FIXTURES.

Frink Show Case and Window Reflectors. Metal bodies with corrugated glass or metal reflectors, having main supply wires with slow-burning insulation and fixture wiring, with rubber insulation. Approved February 3, 1908. Manufactured by

O. P. Frink, 551 Pearl St., New York, N. Y.

Morse adjustable fixtures for mounting on benches or side walls. Cat. Nos. 1 to 5 inclusive. Approved January 3, 1908. Manufactured by

Frank W. Morse, 516 Atlantic Ave., Boston, Mass.

FLEXIBLE CORD, PORTABLE, FOR ELECTRIC HEATERS.

Double or triple conductor cords, composed of braided conductors, with rubber and asbestos coverings, the several conductors separately protected by woven cotton braids and inclosed by an outer glazed cotton covering. Approved December 31, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

GROUND CLAMPS.

Perma Effect. A single strip of hard drawn copper, having the ends secured by a single bolt and provided with a lug for soldered connection to ground wire. Sizes for ⅜ to 3 inch piping. Approved February 5, 1908. Manufactured by

Chas. W. Messner, 3704 N. Broad St., Philadelphia, Pa.

LAMP ADJUSTER.

Style I-H "Universal" adjustable ceiling or side-wall fixture: Wooden rods, with Universal joints, clamps and socket holder. Approved when equipped with approved reinforced cord, February 5, 1908. Manufactured by

Gail-Webb Mfg. Co., 2-4 Lock St., Buffalo, N. Y.

LAMP CLUSTERS.

"Benjamin" newer multiple types, Nos. 5 and 5K, having metal ceiling plates, porcelain bodies and outer shells without removable rings. Approved January 18, 1908. Manufactured by

Benjamin Elec. Mfg. Co., 42 W. Jackson Blvd., Chicago, Ill.

MISCELLANEOUS.

"G. E." combination compensator and socket for A. C. low-voltage Tungsten lamps, 25 watts, 125 V. This fitting is intended for insertion in the ordinary lamp socket and delivers a lamp voltage of approximately 20 volts. Approved February 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

RECEPTACLE FOR ATTACHMENT PLUGS.

Surface receptacle, Cat. No. 812, three-way indicating receptacle and plug for use with electric heating devices, 15 A., 250 V. Approved February 5, 1908. Manufactured by

American Electrical Heater Co., Detroit, Mich.

Flush receptacle and plug. Cat. No. 5551, 15A., 250V. Metal-covered plug, with knife-blade contacts. Approved February 5, 1908. Manufactured by

Harvey Hubbell, Inc., 35 Organ St., Bridgeport, Conn.

RECEPTACLES, STANDARD.

"P. & S.," 3A., 250V. (keyless), and 50 C. P., 250 V. (key), wall sockets, brass shell, Cat. Nos. 387, 0387, 455 and 456. Porcelain Shell, Nos. 2371, 02371, 237, 0237, 247, 0247, 1087 and 107. Cleat Receptacles, Nos. 870 and 871. Moulding Receptacles, Nos. 670 and 770. Sign Receptacles, Nos. 973, 977, 777, 1072 and 975. Removable Ring Type, Nos. 577, 578, 877 and 988. Approved February 5, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

RHEOSTATS.

Drum controllers of types, voltages and horsepower as described in manufacturer's Bulletins Nos. 66, 66A, 67, 67½, 68, 68½, 69, 72B, 77 and 78. Approved when properly installed in connection with suitable resistance elements, January 18, 1908. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Form P and P M resistance units, sizes A, B, and C. Asbestos tubes wound with resistance coil and covered with cement. Approved when suitably mounted on bases of non-combustible material, January 17, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

G. E. motor starting, types S A and S B, with field control type S F A; also type R A speed-regulating rheostats for continuous duty, 125-500V. Approved January 18, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

SOCKETS, STANDARD.

Right Angle and Twin Sockets, with swiveling screw plug attachment. The Twin Sockets are arranged for two lamps in series, Cat. Nos. 941 and 942½. Approved January 18, 1908. Manufactured by

Benjamin Elec. Mfg. Co., 42 W. Jackson Blvd., Chicago, Ill.

Brass shell, key and keyless, Cat. Nos. 9386, 9392, 50760, and 50768, and "Security Snap" Nos. 44147 to 44152, inclusive, 44814 and 44815, also above types with shade holders attached. Approved February 5, 1908. Manufactured by

Marshall Electric Mfg. Co., 301 Congress St., Boston, Mass.

SWITCHES, SURFACE SNAP.

"Arrow E" switches, having old form of terminal, with set-screw binding posts, and new types with binding screw and upturned lug form of terminal. Approved January 30 and 31, 1908. Manufactured by

Arrow Electric Co., 630 Hartford Ave., Hartford, Conn.

SWITCH BOXES.

"M. & M." pressed steel switch boxes for knob and tube work. Replaceable seals. Approved January 3, 1908. Manufactured by

Macken & Mayer Electrical Mfg. Co., Twelfth and Buttonwood Sts., Philadelphia, Pa.

WIRES, RUBBER COVERED.

Marking: Green and black thread parallel to braid. Approved December 31, 1907. Manufactured by

W. R. Brixey, 203 Broadway, New York City.

WIRE INSPECTION.

The Underwriters' Laboratories, Chicago, announces that after extended conferences with the representatives of manufacturers of rubber-covered wires and cords, and following notices sent all manufacturers utilizing the services of the Wire Inspection Bureau, affiliation with that bureau has been withdrawn, and its reports will not be accepted after Saturday, Feb. 29. Stamps or labels issued by the Wire Inspection Bureau and attached to rubber-covered wires, or cords after Saturday, February 29, should therefore not be recognized as having been affixed under the supervision of the Laboratories, representing insurance interests. The announcement further states that during the progress of negotiations resulting in the action reported above, inspection departments, users and manufacturers have requested the inauguration of a system of testing, inspecting and labeling insulated wires and cords at factories which would receive the endorsement of the Laboratories, and the conduct of such a service, along the lines established by the Laboratories for a number of other industries, is under consideration.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MARCH 7, 1908 No. 10

EDITORIAL.

TRANSFORMER OIL.

Transformer oil, its proper character, treatment and use, has been much neglected by central station engineers. It forms one of the weak links in the chain of a high-tension electric-transmission system. In its dual function as insulator and cooler, it requires high dielectric strength and high flash point, combined with great fluidity. It should be neutral so as to not dissolve the insulation of the core and coils immersed in it.

Of these qualities, the dielectric strength is the most variable, for it depends largely upon the amount of moisture present. The popular axiom that oil and water do not mix is not scientifically correct, for oil does absorb a small amount of moisture that materially lessens its dielectric strength. We know of an oil that broke down under 16,000 volts when wet, but stood the test of 40,000 volts after being dried. While oil and water do not chemically mix, they may mingle so closely as to require steam or rheostat heating to remove the water. Every precaution should be taken to keep oil dry during shipment and in use, for it abhors dehydration even more than Nature abhors a vacuum.

It should have a high fire or flash test to eliminate danger of fire. Crude oil is refined by fractional distillation, the most volatile products passing off first. These are low in gravity and in burning temperature, as is exemplified by gasoline. Kerosene for use in lamps is one of the next products, soon followed by an oil suitable for transformer purposes. This usually has a gravity of 30 degrees Baume, or less, and burns at about 300 degrees Fahrenheit. The higher the temperature at which the product is distilled, the greater its viscosity. Consequently what is gained in flashing temperature is lost in fluidity. Acid introduced into the refining must be removed by adding just enough alkali to render the oil neutral. Many other valuable products of oil refining have been and are yet to be found, but "they are another story."

These conditions briefly outlined have been met by various companies supplying transformer oils, each loudly proclaiming the merit of its own product. On the Pacific Coast, Eastern "Mineral Seal" was first used. Later, Western "Mineral Seal" was introduced, it having an asphaltum instead of a paraffine base. Subsequently, "Transil No. 6" and many other oils, whose names are legion, have been offered for sale, much as each druggist sells his own brand of hair restorer. Nearly all these are originally bought from the same company, mayhap the same tank, and have been specially treated to impart the desired qualities. The trade name is a distinction without much difference in quality. Disastrous fires, occurring when the oil has been volatilized by an arc, are credited to one and all of them. Another frequent trouble is the deposition of a thick, carbonaceous, jelly-like sludge on the cooling coils and in the circulating ducts. The former are covered so thick that cooling is not effected, and the latter are so clogged that circulation is difficult. Such deterioration generally occurs when the oil has been overheated. The deposit is easily washed off when hot, but becomes hard and brittle upon exposure to the air, resembling bitumen in this respect. The deposits around the points of high potential allow creepage, so that a medium of high resistance may become a conductor.

But careful examinations of these troubles show that they are usually due to no inherent fault of the oil, but to the transformer design, or more particularly to the attendant's carelessness. It reminds us of the story of Paris, who, because he called Venus the most beautiful goddess, gained the loveliest mortal for his wife, but at the same time incurred the enmity of Juno and Minerva, resulting in the ultimate loss of wife and life. The moral is that he should have attended to his own business and devoted himself to whatever wife he might possess, so as to retain her affections and prevent her running off with another man. The same moral is applicable to the central station man with regard to the claims of the various oil partisans as to their special fitness as transformer insulators. Of far more importance than testing their claims is his own undivided attention to the care of whatever oil he may be using. We have instances of transformers that have been in continuous service for twelve years without any change being made in the oil. As a consequence, is it to be wondered that the transformer runs hot? Its design is condemned by the man who has grossly neglected it. He futilely at-

tempts to remove the difficulty by changing to another oil, temporarily solving the question until this oil, too, becomes unfit for service, and the same trouble again occurs. Careful break-down tests should be made not only when the oil is furnished, but at frequent intervals thereafter, once a month not being too often for main stations. Tests for acidity will avoid the destruction of the insulation by dissolving, and flash tests will often prevent fires. The carbon may be removed by occasional filtering. In case of leaky cooling coils, the water should be drawn off from the bottom until such time as the transformer can be taken out of service and properly repaired.

All this trouble occurs with both water and self-cooling transformers. Where water is plentiful, it has been suggested that outside circulation of the oil would cause better cooling, and larger ventilating ducts would not become clogged. We attain success only by the most careful attention to the details of our work. Look after the oil, and transformer troubles will take care of themselves.

TRADE CATALOGUES.

The Murray Iron Works Company, of Burlington, Iowa, send a handsomely printed and bound catalogue, illustrating and describing their line of safety water-tube boilers.

Bulletin No. 1503, entitled, "Allis-Chalmers Direct-Connected Reynolds Corliss Engines," deals with direct-connected units, a comparison with the belt-driven, however, being offered.

In a handsome booklet known as Bulletin No. 4548, the General Electric Company, Schenectady, N. Y., illustrates typical examples of direct and alternating current motors installed on a great variety of lathes, drills, grinders, punchers, shears, boring mills, and similar tools, which are suggestive of their almost limitless adaptability to this character of service. The pamphlet is bound in a light green cover, bearing in reproduction a photograph of the interior of an electrically driven shop.

PERSONAL.

Alfred Collyer has been appointed sales manager for Canada for the Wagner Electric Co., with offices in the Bell Telephone Building, Montreal, Canada.

George A. Campbell, manager of the Reno Power, Light & Water Company, has taken charge as general superintendent of the Truckee River General Electric Company, operating plants at Carson, Virginia, Yerington, Gardnerville, Reno and other points in Nevada.

Mr. Edward B. Smith, of Philadelphia, has been elected a director of the United Railway Investment Company, which controls the United Railroads of San Francisco and the Philadelphia company. Mr. George H. Earle, Jr., of Philadelphia, also is a director of the Company.

Mr. Willard W. Low, president of the Electric Appliance Company of Chicago and of San Francisco has been in San Francisco during the past week renewing his extensive acquaintance with the local electrical trade. He has been particularly with the great work accomplished since the fire, it exceeding all reports.

COPPER MARKET SITUATION.

New business in copper lately has been very slow, and in the absence of any lively demand prices for electrolytic wire bars have receded to 13. A month ago the market was fully a cent per pound higher than at present, but the extreme indifference manifested by all branches of the trade has rendered it quite impossible to hold prices up to the 14 cent level. Specifications for wire and other mill products are far below normal, and the various manufacturing plants have consequently a great deal of idle capacity which cannot be employed for lack of orders.

The amount of idle machinery waiting for conditions to improve would be hard to compute. In different industrial sections of the country milling operations have been scaled down to a point incompatible with the degree of activity these great plants were designed to reach. The capital and equipment which have gone into many of these establishments fit them for producing heavily, and to be compelled to operate on part time on account of limited orders is a serious handicap. The aggravating feature in such conditions is the fact that the present depression in business is rendered more acute if it is not largely attributable to the persistent vociferations and agitation by those high in authority, which is a direct drawback to the peaceable pursuit of business development on a large scale. The recent denunciations have created a feeling of disquietude in business circles, and there are unmistakable signs that it will take confidence a long time to recover from the assaults made upon it.

The copper situation cannot go it alone, and in sympathy with the general state of affairs it has lost the little tone it seemed to have a few weeks ago. Consumption is so restricted as to be absolutely unable to furnish any stimulus to the market, and rumors of increasing production acts as a damper upon any sentiment savoring of bullishness. Exports of copper also show a material falling off from the high figures, and that means more supplies available here where the outlet is already so narrow. It is not surprising, therefore, to find more pressure to sell and with no improvement to report in the domestic demand it is not necessary to search far for an explanation of the declining market. The enormous export of the past four months has placed a big supply of copper in Europe for English, French and German consumers, and we cannot expect foreign demand to cut a very large figure in the market until the American shipments begin to disappear. A strong all-round demand in this country from the wire people and other consumers is what is needed to put life into the copper market.

MARCH MEETING OF THE A. S. M. E.

The March meeting of the American Society of Mechanical Engineers will be held on Tuesday evening, March 10th, at 8:15 o'clock, in the Engineering Societies' Building. The meeting will be addressed by Dr. Charles P. Steinmetz, member A. S. M. E., past president A. I. E. E., and Professor of Electrical Engineering, Union University, the subject being, "The Steam Path of the Steam Turbine."

TRADE NOTES.

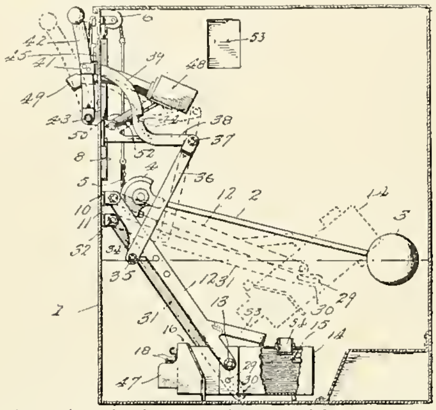
A. C. Thode & Co., of San Francicso, have been awarded the contract for the electrical work to be installed in the El Dorado Brewery, of Stockton, California.

American-made tungsten lamps are gradually appearing on the Pacific Coast. From the Franklin Electric Mfg. Company through the Holabird-Reynolds Electric Company we are in receipt of 40 and 60 watt lamps of 32 and 48 candle power.

PATENTS

SELF-MEASURING TANK. 879,263. John Heissenberger, New York, N. Y., assignor to Automatic Utilities Company, New York, N. Y.

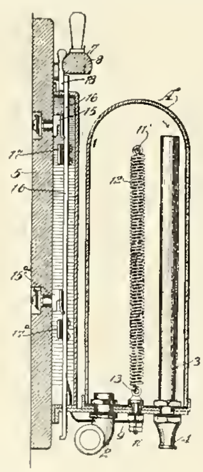
In an automatic or self-measuring tank, the combination with a tank, a swinging measuring receptacle mounted therein, a discharge mechanism normally held out of discharge



position adapted to be brought into position for discharge by engagement with the measuring receptacle, a series of compartments in the measuring receptacle provided each with an outlet, spring controlled valves for outlets, and hand operated levers for acting upon the desired valve to discharge the liquid from the proper compartment of the receptacle.

ELECTRICAL WATER-HEATER. 879,498. Milton H. Shoenberg, San Francisco, Cal.

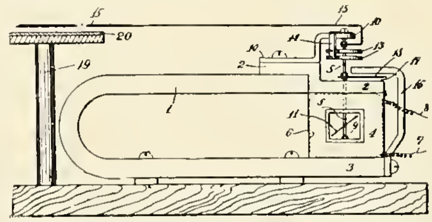
An electrical water-heater consisting of a water-receiver having inlet and discharge passages, a series of naked electrical coils out of contact, extending through the chamber, a standard extending in the direction of the length of the water receiver, contacts with which the opposite ends of the coils are connected, one of contacts being fixedly connected to the standard and extending transverse of the latter a slidable



switch adapted to make or break the circuit by contact with or separation from plates, a lever by which the device is actuated, a water-supply cock having a cylindrical stem extending into the plane of movement of the switch lever, lever operating in a plane substantially parallel with the axis of the stem and stem being cut away on one side to allow the switch lever to move when the water-cock is opened, and to prevent it from moving when said cock is closed.

ELECTRICAL MEASURING INSTRUMENT. 879,385. Adrian H. Hoyt, Penacook, N. H., assignor to Whitney Electrical Instrument Company.

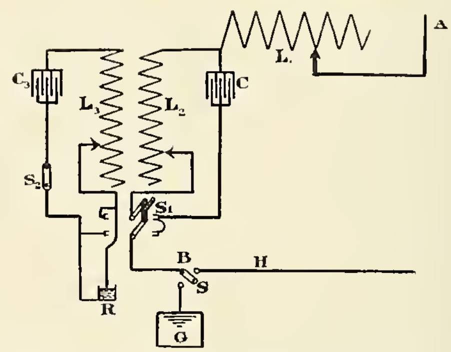
In an electrical measuring instrument, the combination of a magnet, a pivoted shaft, an element mounted upon shaft



in the field of force of the magnet in such manner as not to be moved thereby, a coil carrying current adapted to rotate element, springs opposing the movement of the element, and a mass of dampening material carried by shaft and moving in a magnetic field.

WIRELESS TELEGRAPHY. 879,409. George W. Pierce, Cambridge, Mass., assignor to Massachusetts Wireless Equipment Company.

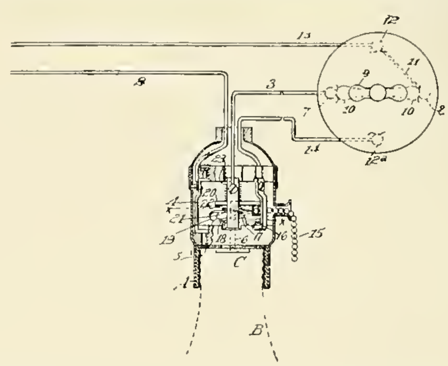
In a receiving system for wireless telegraphy, an induc-



tive connection having a variable secondary, a detector and a condenser connected with the secondary, and connections for sending the currents set up in the primary of the inductive connection through the detector or directly to the ground.

INCANDESCENT-LAMP CONTROL. 879,555. Roy E. Kimball, Fruitvale, Cal.

In an apparatus of the character described, a lamp socket with a plurality of electrical circuits, fixed conducting plates with independent connections through circuits, a post having



connection with the main circuit, a ratchet disk having electrical connection with the post, and carrying arms adapted to make successive contact with the conducting plates, an insulating disk and pawls carried thereby, and means to engage the pawls and advance the ratchet disk.

INDUSTRIAL

KIERULFF AGENCIES.

B. F. Kierulff, Jr. & Co., who have for a number of years had their principal place of business in Los Angeles, as dealers in electrical and telephone equipment and sales agents for a number of large Eastern firms, have opened an office and warehouse at 824 Folsom Street, in charge of Mr. F. E. Stewart, who will look after their lines in the Northern California territory. During the past year they have closed up a number of large contracts in the southern part of the State, among others being one with the United States Government for a large quantity of steel poles for the United States Reclamation Service, and another for steel poles for the Municipal Lighting Plant at Pasadena, California. They are pushing the weatherproof wire products of the Chicago Insulated Wire & Manufacturing Co., of Chicago, and, in addition to securing a large part of the weatherproof wire trade in Southern California, recently closed a large contract with the City Electric Company, of San Francisco.

TRIPARTITE STEEL POLES FOR PASADENA MUNICIPAL LIGHT PLANT, SHOWING A COMPARISON FROM THE ARTISTIC STANDPOINT.

Among the other lines which they will represent is the fireproof asbestos magnet wire manufactured by the Heany Fire Proof Wire Co. This wire has been exclusively adopted by all the electric roads of Southern California for winding their armature and field coils.

Their agencies include the following lines: Chicago Insulated Wire & Manufacturing Co., Chicago, Ill., weatherproof wires and cables; Waclark Wire Co., New York, N. Y., bare copper wires and cables; Heany Fire Proof Wire Co., York, Pa., fireproof magnet wire; National India Rubber Co., Bristol, R. I., rubber-covered wires; Hartman Circuit Breaker Co., Mansfield, Ohio, oil switches; Dielectric Manufacturing Co., St. Louis, Mo., insulating tapes and varnishes; Lord Electric Co., New York, N. Y., Thomas rail bonds, Shaw lightning arresters and Earll trolley retrievers; Sterling Electric Co., La Fayette, Ind., telephones, switchboards and protectors; Bristol Co., Waterbury, Conn., recording instruments; Franklin Rolling Mill & Foundry Co., Franklin, Pa., tripartite steel poles.

This company is also now in a position to take the installation of complete electric power plants, and in this capacity has just finished the installation of a power plant for the Holton Power Company at El Centro, Imperial Valley. They are also representing the American Diesel Engine Company, manufacturing the famous Diesel oil engines.

WESTINGHOUSE ELECTRICALLY-HEATED GLUE POTS.

The Westinghouse Electric & Manufacturing Company is putting on the market a line of improved electrically-heated glue pots that represent the application of electricity in the simplest and most convenient form. The pots are made in two-quart and four-quart sizes, in both portable and bench types. They are made of the best materials for the purpose, and the application of electricity is as simple as it is efficient. There is nothing to get out of order or to require any more attention than is given the ordinary glue pot.

They are especially desirable for use in those crafts where cleanliness is an important factor, where drip from steam pipes means damage to valuable materials, and where the fire risk from a gas-heated glue pot is hazardous. At the same time their convenience and reliability recommend them to all users of glue.

The pots themselves are of seamless drawn copper with brass bail and wiper rod. The water bath is made of seamless copper, and the heating element, which is wrapped around the lower portion, is enclosed in a water-tight tin envelope. The water bath is provided with a patent circulating device, which gives it the maximum heating efficiency. This device consists of a hollow ring, the lower end of which is closed by a diaphragm having a central opening. This confines the heating action to the thin film of water outside of the device, and sets up a rapid circulation in the water, which brings the glue up to the working temperature in a short time.

To further promote economical heating, the pots are provided with heat regulating switches, by means of which the glue can rapidly be brought to the desired temperature, and then maintained there by a lower temperature of current. The accompanying picture shows the parts of the four-quart portable pot, including the water circulating device. Electrically-heated dry glue pots are made for those industries where the water bath glue pot is undesirable.

THE DURABILITY OF MODERN ELECTRICAL APPARATUS.

Electrical apparatus, when constructed in accordance with the best engineering practice, is well nigh indestructible if subjected only to the ordinary amount of wear and tear, and often comes out with flying colors from the devastating reign of floods and fires. The few incidents quoted below are excellent examples of the amount of hard usage that well constructed electrical apparatus will survive, and still be in working condition.

In the Knights Deep Mine near Johannesburg, South Africa, there were installed thirty-six 15-kilowatt transformers, and twelve three-phase, 50-horsepower General Electric induction motors for operating the mine pumps. Through a peculiar combination of circumstances, the mine was allowed to fill with water, the motors and transformers remaining under several hundred feet of water for over two years.

When taken out, three of the motors were rewound in the local repair shop. The others were simply dried out and then soaked in oil. Contrary to all expectations and to the surprise of all concerned, the insulation was found to be in excellent condition, and the motors were put into service, apparently none the worse for their high pressure bath. The transformers were treated in the same manner, and shortly afterward they replaced several transformers of English make, which had burned out only a short time after being installed.

A railway power station situated near the Mississippi River experienced a severe flood during the season of high water. Two 1,500-kilowatt, 6,000-volt generators were more than half under water for nearly a week, but when dried out carried their load without giving any trouble whatever. In fact, the first machine to be dried out, carried the entire railway load until the second machine could be put into condition.

A three-horsepower induction motor was taken from the ruins of the printing office of "The Democrat," Ellsworth, Maine, some few days after the entire building had been destroyed by fire. After being freed from the protecting coat of ice and cinders, the motor was dried and cleaned. When connected to the circuit is ran as smoothly as when first installed. Some idea of the intensity of the heat to which the motor was subjected may be gained from the fact that the switchboard and instruments were completely destroyed.

A General Electric 20-horsepower, 550-volt, 3-phase induction motor, installed in a leather warehouse in Salem, Mass., was subjected to a severe ordeal during a fire. After the building and its contents had been deluged with water, the motor was removed, and after being cleaned, dried and fitted with another pulley, started immediately on application of the current. The motor has since carried its rated load, and does not appear to be damaged in any way except as to appearance.

Another excellent example of the durability of the induction motor was shown by the remarkable performance of a General Electric 5-horsepower motor, which was used in driving a pump in the G. H. Perry Co.'s quarry in South Dakota. The motor was often allowed to run without any attention over night, especially during the rainy season. One night a heavy rainstorm filled the quarry to such a height that the motor was half under water. When started the next morning, it picked up its load and carried it steadily until the pit was emptied of water. On examination it was found to be none the worse for its prolonged bath, although a new pulley had to be put on in place of the old one, which was softened and warped out of shape.

Several hundred General Electric flat irons passed through the San Francisco fire, and aside from the fact that the wooden handle was destroyed and the iron slightly disfigured, the iron was as good as ever.

An opinion was filed in the United States Circuit Court of Appeals for the District of New Jersey, sustaining an opinion rendered some time ago in favor of the Westinghouse Electric & Mfg. Company against the Prudential Insurance Company, of Newark, N. J.

This suit, brought by the Westinghouse Electric & Mfg. Company against the Prudential Insurance Company, of Newark, N. J., to restrain it from further infringement of Nolan patent No. 582,481, in the use of a direct-current generator manufactured by the Bullock Electric Mfg. Company, was decided in favor of the Westinghouse Company in the U. S. Circuit Court, District of New Jersey, and now the Court of Appeals sustains the opinion of the lower court, holding that claims 2 and 4 of the patent are valid and infringed by the use of the Bullock generator in question.

The feature of the direct-current generator to which this patent relates, is the means used for clamping the armature laminae in place, and the particular feature is the means for holding the movable clamping ring or flange in position, a split ring partially located in a circumferential groove in the armature spider being used to hold the clamping plate in position, the ring itself being held from centrifugal movement by a shoulder upon the clamping plate. This is an important feature of construction, as it obviates the use of bolts passing through the laminae for the purpose of holding them together.

The business of the Westinghouse Machine Company during the month of February has continued to show the most encouraging signs of improvement. Quite a number of excellent orders have been received in the various departments. There is as a result much greater activity in the shops at East Pittsburg. Unusually large shipments have been sent from the works on export delivery, including several large steam engines. One of these shipments, consisting of five 125-horsepower compound engines, was consigned to Takata & Company, the Japanese agents of the Westinghouse Companies in Tokio, for delivery to a manufacturing plant in Canton, China. Another compound engine of 500-horsepower capacity also included in this shipment was consigned to the same firm for delivery to the Southern Japanese Railway Company, of Kaisha, Japan

The receivers of the company are reporting very encouraging progress with the plan of rehabilitating the company, and it is now expected that its affairs will again be in the control of the stockholders within a very few days.

An interesting incident showing new advantages of motor drives turned up recently. A large Ohio paper mill ordered several engine-type generators of the Northern Electrical Manufacturing Company, Madison, Wis. Through an oversight, the customer did not specify who should mount the armature on the engine shaft, and thus neither the engine builder nor dynamo manufacturer made provisions for mounting the armature. When this was discovered, after erecting operations had begun, it was found that no jobbing shop was in a position to handle a force fit of about 150 tons. Accordingly, the Northern Electrical Manufacturing Company shipped from its works one of its motor-driven hydraulic presses, with necessary rigging for pressing the armature on the shaft. A small generator was rigged up to furnish current, and the job of pressing completed in short order. Had not the portable motor-driven outfit been available, considerable delay would have been necessary, and much expense to ship the armature and shafts to the engine builder's factory for mounting.

NEWS NOTES

TRANSPORTATION.

Visalia, Cal.—F. S. Granger is planning to build an electric road from Tulare to Porterville.

San Diego, Cal.—E. W. Peterson has made application for a street car franchise at South San Diego. The franchise applied for will connect the first franchise, obtained last month, with Imperial Beach, a new tract.

Los Angeles, Cal.—Promoters of the scenic railway along the rim of the Grand Canyon of the Colorado, in Arizona, are in Los Angeles perfecting plans for the railway. Should the road be built gasoline motors will probably be used.

San Francisco, Cal.—The Board of Health has submitted to the Board of Supervisors the draft of an ordinance designed to prevent smoking in street cars. The proposed measure makes it a misdemeanor for any one to smoke a pipe, cigar or cigarette in any street car, no recognition being given to a "smoking apartment" therein, such as now exists in the newer cars in use.

San Francisco, Cal.—In a suit brought by the Pacific Electric Railroad Company to compel A. Campbell-Johnson, C. S. Campbell-Johnson and the San Rafael Ranch Company to perform a contract entered into to turn over to the railroad company rights of way and franchises between Los Angeles and Pasadena, the Supreme Court affirmed the judgment of the lower court denying the petition of the railroad company.

San Bernardino, Cal.—A contract was signed this week under the terms of which the Pacific Light & Power Company supplies the San Bernardino Valley Traction Company with the necessary electrical power to operate its system. Since the traction company has been in business here the power has been furnished by the Edison Electric Company, of Los Angeles. The Pacific Light & Power Company will bring its power for the traction system from its plants in the Santa Ana Canyon.

OIL.

Coalinga, Cal.—The general land office is investigating claim jumping in the Coalinga oil fields. It is disclosed that many persons have filed homestead entries on land where mineral locations have been made, and where labor has been performed with the evident intention of developing for oil purposes. It is charged that a majority of these second filings have been made for the purpose of securing claims of 160 acres each from the oil men who are entitled to them.

Salt Lake City, Utah.—An oil refinery to cost not less than $200,000, will be built in the Uintah field by the Tonopah and California interest now ready to start drilling there, in the event that the new wells to be sunk are able to match the results already obtained by the Tunnel Oil Company, which has a small refinery on the ground. This is the report of John T. Pope, president and manager of the Tunnel Oil Company, and a director of the Uintah Pioneer Oil Company.

San Diego, Cal.—Announcement is made that the Union Oil Company is shortly to enter the San Diego field as a competitor of the Standard Oil Company, which for years has occupied this part of the State without competition. B. W. McKenzie, president of the Western Metal Supply Company, San Diego agent of the Union Oil Company, states that a site for the erection of a large plant has been secured. This site consists of several acres at the foot of Tenth Street, immediately adjoining the tracks of the new San Diego and Arizona Railroad. Six tanks are to be erected at the start, and a number of other improvements are to be made without delay. Refined oil products of all kinds are to be handled in San Diego by the Union Oil Company, which has heretofore contented itself with the shipment and marketing of crude oil only.

ILLUMINATION.

San Diego, Cal.—A resolution has been adopted by the Council ordering work commenced for placing ornamental lights along Sixth Street between G and E Streets.

Needles.—A party of Los Angeles men have entered into a contract with the Victor Gold Mining Company, and will take from the company electric light power sufficient to light and supply power to Needles. They have commenced the erection of transmission lines throughout the city, and are now furnishing light to some buildings.

San Bernardino, Cal.—It is planned by San Bernardino and Redland capitalists to establish a gas plant at Colton, to supply gas to the Home Gas Companies at Redlands, San Bernardino, Colton, and to a new system to be built in Riverside. The principal backers of the plan are J. Benjamin, of San Bernardino, and C. S. Chesnut, of Redlands.

San Francisco, Cal.—General Manager Black, of the United Railroads, has informed the artificial lights committee of the Supervisors that the company would enter into a contract within a few days for the ornamental poles to be erected in Market and Valencia Streets. He expects to have them in position before the arrival of the fleet. The expense of lighting will be borne by the city. Representatives of various improvement clubs presented designs of poles they contemplated using in the down town streets. The committee instructed them to hold a conference and unite on a design, as the Board would not agree to the erection of poles of different designs.

TRANSPORTATION.

Richmond, Cal.—The bid of John Nicholl for a street railway franchise has been accepted by the Trustees.

Los Angeles, Cal.—All lines of the Los Angeles Pacific are being made broad gauge. Subways will be constructed between this city and Venice, and the Hill Street tunnel will be completed.

Chihuahua, Mexico.—The directors of the new local electric street railway company, A. C. Nash, manager, gave orders this week to commence work on construction of the lines within the city.

San Francisco, Cal.—The street-car strike committee of the Building Trades Council and Labor Council met for the last time this week and disbanded. Of the $400,000 contributed to the fund by the labor unions of the city, State and country, $1400 remains.

Reno, Nev.—At the last City Council meeting the resolution granting a franchise to S. H. Wheeler and Charles Burke, both of this city, to construct an electric railroad over the various streets of Reno from the Southern Pacific depot into the southeastern portion of the city, was passed.

Los Angeles, Cal.—Bids for the sale of the San Pedro South Park Street trolley franchise will be received on March 23rd. The City Council voted to allow the Los Angeles Railway Company its claimed portion of the thoroughfare on San Pedro Street, but will advertise the remainder of the street south of Thirtieth.

Los Angeles, Cal.—J. B. Brockaw and other Hollywood capitalists are planning an electric line up the west slope of Mt. Hollywood and the erection of a pavilion on the top. The incline will be 2500 feet. The route has been inspected by Councilmen, and President Niles Pease of the Council states that the franchise will probably be advertised.

Riverside, Cal.—Because of a question as to the validity of the franchise heretofore granted to A. C. Denman, Jr., the San Bernardino Interurban Railway Company asked the advertisement of the franchise for a line along First Street from Colton Avenue to the Main Street line. The measure was passed to a second reading. Bids will be received until March 24th.

Oakland, Cal.—The railroad committee of the Oakland City Council has recommended for passage a franchise which will enable the Oakland Traction Company to operate a line of cars along East Sixteenth Street from First Avenue to Twenty-second. A ten-minute service will be given. The line is in the nature of a compromise between the residents of East Oakland and the traction company.

THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MARCH 14, 1908 No. 11

ELECTROLYTIC REFINERY AT THE SAN FRANCISCO MINT.

By ARTHUR H. HALLORAN.

All gold and silver coined at the San Francisco Mint is now being refined electrolytically. This refinery was placed in partial operation on March 5th, 1908, and to date has been operated satisfactorily. It is the third electrolytic refinery that has been installed in the Mint service, the process having been first developed at the Philadelphia Mint, subsequently put in at Denver, and finally installed at the San Francisco plant, being modified as suggested from experience at the firt two plants, under the direction of Mr. Robt. L. Whitehead.

Two methods are in use: the Wohlwill, for gold, and a modification of the Balbach process for the silver. The former involves several changes in the process of Dr. E. Wohlwill, who was the first to successfully refine gold electrolytically, having advanced the principle that it is impossible to affect the electro-chemical solution of gold, in an electrolyte of neutral gold chloride. The anode consists of alloy gold, having a fineness of about 850 as received from the deposit melting room. The electrolyte is a solution of tri-chloride of gold, with an excess of free hydrochloric acid. The cathodes are very thin strips of pure gold, 999.9 fine. The electric current carries the gold from the anode through the electrolyte and deposits it on the cathode, these being about one-half inch apart and suspended vertically.

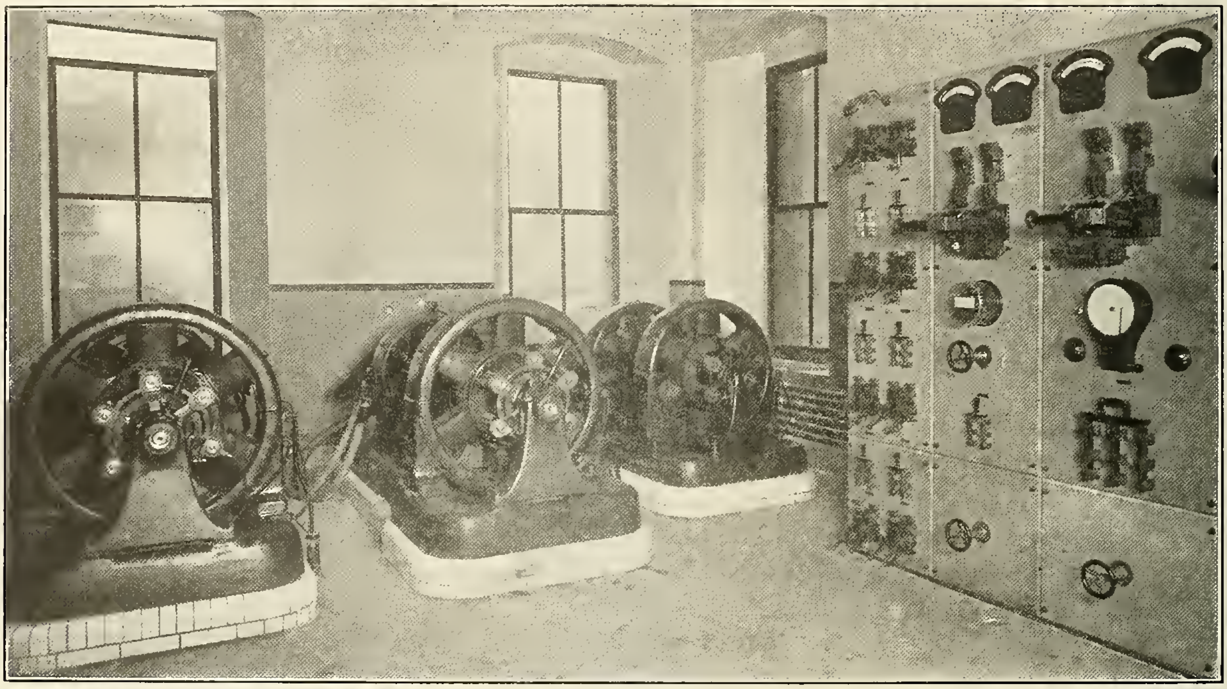
CELL ROOM IN ELECTROLYTIC REFINERY AT SAN FRANCISCO MINT.

In the silver refining there is a graphite cathode and a dore anode, both being suspended horizontally in a basket containing the electrolyte, a solution of silver nitrate with excess of nitric acid.

Having briefly outlined the two processes employed, we are at liberty to take up a detailed examination of the plant. It consists essenetially of four parts—generating,

refining, melting, and an experimental laboratory. These are all on the second floor of the building, and will be described in the order mentioned.

Generator Room—As shown in the accompanying photograph, this room contains the three motor-generator sets, supply current at 15 volts, and the other is a 250-volt board, and also a small set for copper deposition. Direct current at 250 volts is obtained from the mains of the San Francisco Gas & Electric Company. This is reduced in voltage and raised in amperage by means of three motor-generator sets. Two temporary ones consist of a 30-horse-power, G. E., 6-pole, continuous-current motor, 105 amperes, 250 volts, direct connected to a 1,000-ampere Eddy dynamo supply current at 15 volts, and the other is a 250-volt 88-ampere, G. E., 6-pole motor, and 25-volt, 500-ampere, G. E. generator. Each set can be operated independently



MOTOR GENERATOR SETS AND SWITCHBOARD.

on either gold or silver cells, or both sets can be used to supply either one. The Engineering Specialities Co. will install a 200-ampere, 6-volt set for copper work, similar to one now in the experimental laboratory, this last being so designed as to deliver its full current output at any voltage up to the maximum. Block brushes containing a high percentage of copper with sufficient graphite to give perfect action and high durability are used, being attached so that while it is fed with uniform tension the position on the commutator is not changed as it wears. This prevents irregular action and undue wear, and insures sparkless operation and cool running, even under heavy loads, 170 amperes to the square inch having been carried in the test run. The sets are mounted on foundations of glazed brick, the floor in this and all other rooms consisting of slabs of Albarene soapstone.

The main switchboard in the dynamo room consists of six panels, three being motor and three generator, two for each of the three motor-generator sets. With it is an auxiliary switchboard from which are controlled the centrifugal pumps, the elevator and the apparatus in the rolling room. The panels are of Alberene stone two inches thick, hone-finished on both sides. The picture shows the auxiliary and two of the main panels, the other four continuing to the right. The auxiliary panel is 24 inches wide, as are also the three motor panels. The generator panels are 30 inches wide, giving a total length of 15 feet 6 inches. The panels are eight feet high, six feet being in the main board and two feet in the base. The equipment of the motor panel for the 25-volt set consists of one 100-ampere Weston ammeter and one 300-volt Weston voltmeter, one 100-ampere, double-pole, overload, no-voltage release, time-limit, I. T. E., type L. L., Cutter circuit breaker, one 100-ampere Sangamo recording wattmeter, one Cutler-Hammer motor field rheostat, one 100-ampere double-pole, double-break knife switch, and one G. E. starting rheostat, S. A. type. The generator switchboard of the same set consists of one 750-ampere Weston ammeter, one 35-volt Weston voltmeter, one 600-ampere circuit-breaker, one 800-ampere Bristol recording ammeter, two red bulls eyes, one 600-ampere, double-break, triple-pole switch and one G. E. generator field rheostat.

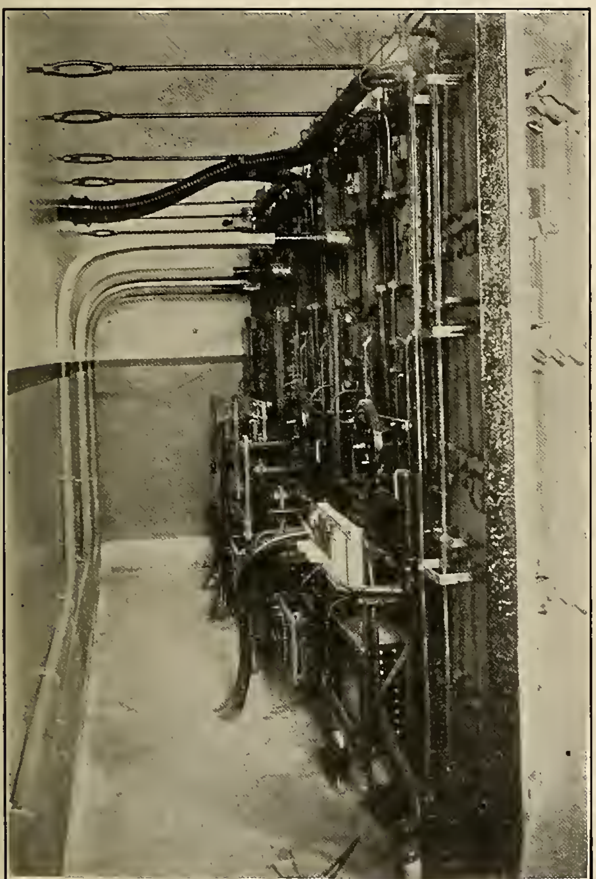
The other two sets are each controlled from similar panels with slightly different equipment. The motor panel has a 200-ampere Weston station ammeter and a 300-ampere Weston voltmeter. The same type of circuit-breaker is used, it having a capacity of 200 amperes; also a 200-ampere Sangamo wattmeter. One Cutler-Hammer motor field rheostat, one 200-ampere, double-pole, double-break knife switch and one G. E. motor starter, S. F. type, completes this panel equipment. The corresponding generator panel has a 1,500-ampere Weston ammeter and a 25-volt Weston voltmeter, a circuit breaker with a capacity of 1,250 amperes, a 1,600-ampere Bristol recording meter and a switch for 1,200 amperes, being arranged for double throw to either silver or gold cells. A G. E. generator field rheostat completes the front equipment.

The auxiliary switchboard is equipped with a circuit-breaker and switch for each of the circuits that it supplies. These include a 5-H. P., G. E., C. Q. motor, running the centrifugal pump, an Otis elevator having a speed of fifty feet per minute, a 15-H. P. type-S. variable-speed, Westinghouse motor, operating the water-cooled rolls, a 5-H. P., G. E., C. Q. motor operating a 200-ton hydraulic press, a

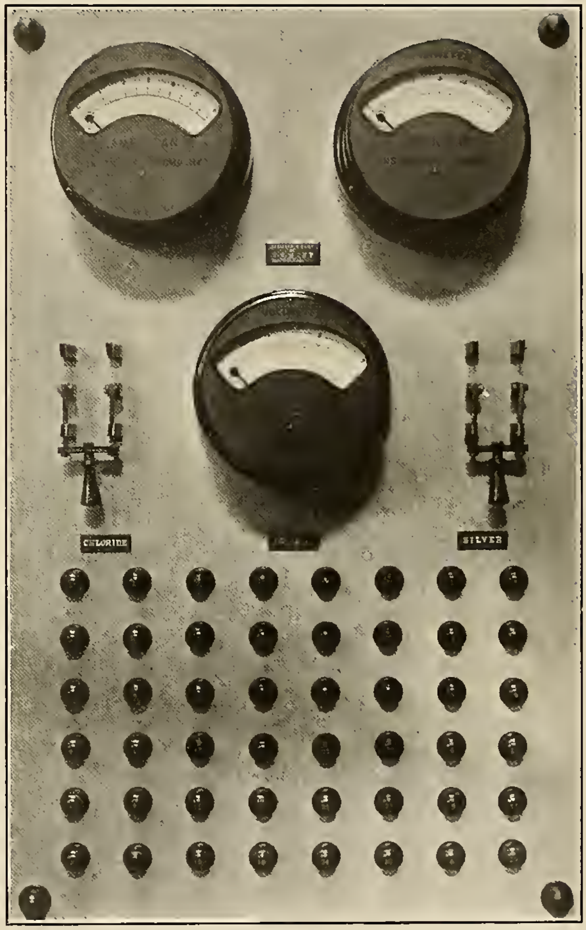
cutting machine, and a 10-H. P. motor running a Sturtevant blower supplying the air for the melting furnace.

The panels are supplied by separate circuits from the main board in the basement through an old flue running to the attic, from which lead-covered, Grimshaw, rubber-insulated cables are run in Bossert electro-duct conduit to the switchboard. The wires from the board to the motors are run through two 2-inch and one 1½-inch conduits placed underneath the floor. Of the stranded lead-covered wire, 00 supplies the 30-H. P. motors, 0 the 25-H. P., and 0000 the auxiliary board.

The feed from the 1,000-ampere generators to the board consists of four 2,000-circular-mils, paper-insulated, lead-covered cables, and for the 500-ampere set consists of two 1,000-circular-mils cables. These are run through iron pipes set flush against the wall and strapped to it so as to give a rigid support, going first to the circuit-breaker. All the lugs on the back of the board have been specially designed.



BACK OF MAIN SWITCHBOARD.



LABORATORY BOARD SHOWING CONDITIONS IN REFINERY.

The current from the board to the gold and silver tanks is carried by four 1,000-circular-mils, paper-insulated, lead-covered cables which terminate in specially-designed lugs. These lugs are enclosed in Alberene stone boxes, six inches each way, which have been filled with beeswax and rosin to protect the copper from acid. From thence the wires run to the copper strips to which the cells are connected. The 30 gold cells are connected in series, and the 12 silver cells in series parallel.

The main busbars have a capacity of 1,250 amperes, being composed of three 4x⅛-inch copper bars, laminated, This switchboard was built and installed by the Walker Electric Co., but all the wiring and work in connection with it, as well as the other wiring throughout the plant, was done by Mr. John J. Marshall, Chief Electrician of the San Francisco Mint, to whom credit is due on account of the neat and workmanlike manner in which the job was finished. There is a space of four feet at the back of the board and all incoming and outgoing wires have been carried so that there is no obstruction to walking, and all connections have been made so as facilitate testing and reduce breakdowns to a minimum. The accompanying photographs illustrate the excellence of this work better than do the writer's words.

A smaller board is to be built in the cell room, by means of which the cell man will know the current consumption without having to go into the dynamo room. This board will be equipped with two 1,500-ampere and one 750-ampere ammeters, and two 25-volt and one 35-volt voltmeters. All these instruments are being supplied by the American Instrument Co., and are also mounted on Albarene stone.

The working of this entire system is made known in the office of laboratory by means of a board specially designed in the San Francisco Mint. As shown in the accompanying photograph, by pressing one of the forty-eight buttons on the board the ammeter and voltmeter will record the conditions in the cell desired. These buttons are numbered from 1. to 6. for the chloride cells, from 1. to 30. for the gold cells, and from 1. to 12. for the silver cells. The voltmeter from the chloride and silver cells registers from 0 to 6. and that for the gold cells from 0 to 3. The double-throw knife-switches can be changed to either of the two large meters, connected so as to show the voltage between any two tanks. Busbars are stiips of 3⅛-inch x No.

21 hoop brass. No. 18 rubber-covered Grimshaw wires in iron conduits are run from this board through the bottom of the cell tables to each tank.

The cell room is lighted by means of four 250-volt G. E. enclosed arcs, the rolling room by two, and the melting and generator rooms by one each. All offices and laboratories are lighted by incandescent lamps in Hubbell separable pull clusters.

Gold Refining—Formerly all the gold from the deposit room was alloyed with silver in the proportion of one part of gold to two and one-half parts of silver, there being present from one to two per cent base. Treatment with hot concentrated sulphuric acid dissolved all but the gold which was remelted, to give a fineness of about 995. Silver was precipitated by copper from the sulphuric acid solution and pressed into cakes for convenient melting. The copper was recovered as blue-stone by evaporating the solution.

For ten years electrolytic processes were developed at the Philadelphia Mint, beginning as small laboratory experiments and developing into a plant having a weekly capacity of 90,000 ounces of gold and 375,000 ounces of silver. It has been found cheaper, neater and cleaner than the process just described. The practical work at this plant and at the Denver Mint has shown certain modifications to be desirable. Precipitation is carried on in Royal Berlin porcelain tanks each 13½x18 inches in cross-section and 12 inches deep, this ware being unaffected by chemical action. These cells are arranged in two rows of 15 each, supplied with electrolyte by a central trough with side-supply discharging into a trough on either side. In the final installation the solution will be continuously circulated by a porcelain plunger pump, but temporarily the cells are filled by hand and agitation in each cell is caused by glass propellers belt-connected to a G. E. motor. These cells rest directly on great slabs of Alberene soapstone, which are supported on glazed brick pillars. In each cell are suspended six anodes and six cathodes.

The anodes consist of slabs of deposit gold, each eight inches long and three and one-half inches wide and about one-half inch thick, tapering at one end. They are cast with holes for suspension from porcelain rods. These porcelain suspenders are used both for anodes and cathodes, and are covered with strips of pure gold, to conduct the current. The anodes are blended from gold as low as 800, with gold of 990 or over, so as to give a fineness of 940 or 950, the balance being silver and base. More than five per cent of silver interferes with the working, as it is the only part of the anode not dissolved in the electrolyte, being precipitated onto the anode as a chloride. This adheres tightly to the anode if in excess, instead of dropping to the bottom of the cell as it should. If it sticks to the anode the voltage may be increased fully twenty-six per cent, the anode area is reduced and gaseous chloride is evolved and the proportion of the gold in the solution is lessened. The base consists of copper, lead, zinc, bismuth, tellurium, platinum, etc. This is dissolved in the electrolyte, but fouls it after a time, being removed as described later.

The electrolyte consists of an acid solution of gold tri-chloride containing from fifty to sixty grams of metallic gold to the liter and from five to ten per cent of free hydrochloric acid. Ordinarily chloride of gold is prepared by dissolving the metal in nitro-hydrochloric acid (aqua regia), and driving off the nitric acid by heat. But by aid of the electric current nascent chlorine dissociated from the hydrochloric acid unites with the gold to form the chloride. This eliminates nitric acid in this process.

The cathodes are strips of 999.9 fine gold rolled to a thickness of 1-100 of an inch, being ten inches long and three and one-half inches wide. After enough gold has been deposited on them they are carefully placed in specially-designed porcelain filters which are mounted on trucks and run close to the cells whence the cathode is lifted by the cell man. When the filters have been filled they are carried by an elevator to the filtering platform and washed with hot water for half an hour, the loaded filters are then run into steam drying ovens, and when dry are returned to the melting room. Thus the gold is not handled after leaving the cell man until it reaches the melter.

The filtrate and wash water are run into large earthenware tanks, where any gold present is thrown out of the solution with ferrous sulphate. The remaining solution runs by gravity into iron tanks below, being filtered on its way down, where any copper, platinum, etc., present are precipitated as cement copper, being replaced by iron. Steam coils are used to heat the solution and hasten the reaction. It is then pumped into a storage tank above and evaporated by means of lead steam-coils until sufficiently concentrated to be used to precipitate the gold from the foul solution as before described, the iron being in a ferrous state.

The cement copper is melted into anodes and subjected to electrolysis, the copper being deposited on the cathodes and the other metals forming a slime that is treated only for the platinum, palladium, gold and silver it may contain.

The plant has been in operation such a short time that no details of operation are yet available. The slimes constitute from five to ten per cent of the output of the cathodes, consisting of from ninety to ninety-five per cent gold. Two electric-driven centrifugal driers, made in Germany, facilitate rapid handling of all filtrates and other products. A current density of 60 amperes per square foot of cathode surface has dissolved similar anodes in thirty-six hours. The process works to commercial advantage at 100 amperes or over, fouling the solution somewhat more rapidly and requiring more frequent additions of gold chloride. In a report of the Denver plant, as written by Mr. Robt. L. Whitehead, in the Report of the Director of the Mint for 1906, he states: "The higher the current density maintained, the purer will be the deposit, provided a uniform temperature be maintained and there be sufficient gold in the solution to prevent a spongy deposit, which means there should be over thirty grams to the liter. The absence of sufficient free acid is always shown by 'gassing' at the anodes."

Silver Refining—The silver electrolyte consists of two per cent silver nitrate solution acidified with from two to three per cent of hydrochloric acid, and is pumped by means of earthenware centrifugal pumps driven by 4-H. P. G. E. motors, into a large Bertuch earthenware jar, from which it is distributed by a central trough to the silver cells. Side discharge into a return trough gives the solution continuous circulation. These cells are twelve large Bertuch earthenware tanks, each 47 inches long, 26 inches wide and 12 inches deep, arranged in two rows of 12 each. Suspended in each tank are two earthenware perforated baskets. A cloth filter is put in to collect any residual gold sludge, and on it is laid horizontally the

graphite cathode. Six inches above these is suspended horizontally a dore cathode, consisting of from 970 to 980 parts of silver and from twenty to thirty parts of gold. The foundations of these tanks are likewise glazed brick on which are placed three-inch slabs of Albarene soapstone. The same system in handling the product of these silver cells is used as in the gold cells, with the exception that the silver is recovered in a powdery form on the cathodes, being periodically removed from them by rubber shovels. This is pressed into cakes and remelted, as in the old process. In time the solution becomes fouled with copper and lead. By adding sulphuric acid the lead is precipitated as lead sulphate, and the copper is replaced by iron. This copper is cast into anodes and from it is recovered any remaining gold and silver. The Waterbury Farrel Foundry & Machine Co. is installing, in a room next the melting room, a rolling mill for rolling the gold cathodes, and a 200-ton hydraulic press for compressing the silver and the copper residues.

platinum was supplied by J. Bishop & Co., is ample for all requirements. Table tops, reagent racks, weighing and mixing shelves, sinks and floors, are all of acid-proof Albarene soapstone. All the acid-boiling hoods throughout are made of this stone.

Pending an illustrated account of the electric apparatus furnished by Justinian Caire Company of San Francisco through Eimer & Amend of New York City a list of it will indicate how completely the laboratory is equipped for delicate work. It includes two Prometheus electric heating plates 12x18 inches using up to 1500 watts and arranged for three separate heats; a Simplex drying oven 12x14 inches inside with connections for three peats, a Kryptol crucible furnace for crucibles 10x9 cm. and a Kryptol bath 20x30 cm. This Kryptol is a black granulated resistance material which becomes hot when subjected to an electric current. It is said to produce any temperature up to 25,000 by varying the thickness and the current. Direct current at 220 volts is used in all this work. In addition there is ample provision for electrolytic work.

MELTING ROOM.

LABORATORY.

Melting Room.—The melting room in connection with the refinery (as shown in the accompanying picture), is equipped with four large oil-burning crucible furnaces. An oil-burning reverberatory furnace, part of which is shown on the extreme left, in the foreground of the picture, and an oil-burning cupel furnace, complete this department. The furnaces are made of steel plate and angle iron bolted together. They are lined with 9-inch fire brick, which will have to be replaced every two or three months. The crucible furnaces give a heat of 2,600 degrees or over, and melt from five to six thousand ounces at a time. The idea is to give a quick heat to reduce the volatilization loss. An electric-driven Sturtevant blower supplies the air blast. From a reservoir outside of the building oil is pumped by duplex steam pumps in the attic above the refinery.

Exhaust steam is used to heat the oil, so that it is delivered to the burners at about seventy degrees F. This preliminary heating aids combustion and reduces the amount of deposited carbon in the chamber. All of this equipment was put in by the Rockwell Engineering Co., of New York City.

Experimental Laboratory—Not the least interesting part of this installation is the laboratory. In addition to the usual apparatus and reagents necessary for the ordinary run of work, it is supplied with electric hot plates, annealing ovens, evaporating baths and furnaces, for experimental work. It has a small motor-generator set and a special switchboard for electrolytic determinations, and, in addition has a portable ammeter, voltmeter and ohmmeter, this latter being supplied by the Whitney Instrument Co. The

In conclusion, it may be said that the electrolytic methods which have displaced the old methods of refining, are much superior. It is found that the gold supplied the coiner is more easily worked, and contains no platinum to destroy the dies. It is also cheaper and quicker, this last being an important item in reducing the large interest charges that are ordinarily locked up with so much idle metal, although this matter is not so important to the Government as it would be to a private concern, as it pays no interest on its gold.

Ten mercury arc rectifiers are used to transform single-phase, constant-potential alternating current into constant direct current for the operation of 750 four-ampere continuous-current series arc lamps by the Portland General Electric Company. The ninety per cent efficiency claimed at full load is better than the eighty per cent obtained with a motor-generator set. The lamps require eighty volts each, with a starting voltage of ninety.

Patent for a process for producing poreless and well-adhering electrodeposits has been granted to Harry Schmidt, Schmidt, Cologne Germany. It consists in first providing the metal to be electroplated with a coating of a metal or alloy which melts at a lower temperature than the final electrodeposit, in then electrolytically depositing the final coating, and in melting the intermediate coating.

CENTERVILLE TURBINE INSTALLATION.

By Jas. H. Wise.

Concerning the Centerville Turbine Installation and Mr. Homberger's discussion of the original paper, the writer wishes to amplify some of the statements made therein. In this particular installation a constant quantity of water is flowing in the Centerville Canal, and as there is no chance for storage, either at the upper end, or lower end of the canal, it is necessary in order to get full use out of the water, to keep the Centerville unit on the line at full load for twenty-four hours out of the day. If the water is not used for generating power, it is either by-passed, or is spilled into a natural water course and its useful energy is lost. The average efficiency of the installation is therefore high, and the considerable waste of water referred to by Mr. Homberger, due to regulation, does not enter into the discussion. The turbine has lately been operating with a load factor of about ninety per cent, and has practically been on the line continuously. The pressure regulator was designed for speed regulation as well as for relieving the pipe line and wheel casing of excessive pressure, due to water hammer. It is not a device for economizing water.

The precautions to guard against the wear of the guide and runner vanes are no more than have been taken in the case of impulse installations on various parts of the system, and in fact, more effective means are generally used, in as much as large forebays, or reservoirs of several million cubic feet capacity are used for regulation, and this effects the settling of all silt and detritus, giving very clean water for the wheels. This arrangement was impossible for the Centerville installation, due to the steep side hill slopes at the termination of the canal.

Mr. Homberger treats very lightly the subject of a two or three hundred pound bucket leaving the disc during operation; the writer knows of two instances where the sudden breaking of a bucket caused the complete destruction of the entire wheel.

The writer will say that he feels he is familiar with the progress that has been made on vertical shaft, multiple jet, impulse wheels, and is also acquainted with the fact that the same firm of prominent Eastern engineers who installed the plant in Mexico with vertical shaft, two jet, impulse wheels, is at the present time supervising a very large installation in California where Francis turbines are to be used exclusively. The installations are, however, not to be compared, for the impulse wheels above mentioned are under a head of about 1300 feet, while the turbine installation will have an ultimate head in the neighborhood of 500 feet.

The fact that the Pelton Water Wheel Company, the chief Western competitor of the Doble Water Wheel Company, with which Mr. Homberger is associated, has also undertaken Francis turbine design and construction for medium heads and high speed, would seem to be an acknowledgment on the part of the wheel builders that there is a special field for each type of wheel.

The wireless telegraph station at Mare Island, California, on March 8th received a message from Admiral Evans, 1,300 miles south of Magdalena Bay, a total distance of 2,600 miles. The message was repeated from the St. Louis at Magdalena Bay, and told of a marine's death and burial at sea.

PREVENTION OF WOOD DECAY.

It is estimated that a fence post, which under ordinary circumstances will last for perhaps two years, will, if given preservative treatment costing about 10 cents, last eighteen years. The service of other timbers, such as railroad ties, telephone poles, and mine props, can be doubled and often trebled by inexpensive preservative treatment. To-day, when the cost of wood is a big item to every farmer, every stockman, every railroad manager—to everyone, in fact, who must use timber where it is likely to decay—this is a fact which should be carefully considered.

It is easy to see that if the length of time timbers can be used is doubled, only half as much timber will be required as before and only one-half as much money will need to be spent in the purchase of timber. Moreover, many woods which were for a long time considered almost worthless can be treated and made to last as long as the scarcer and more expensive kinds.

Of the actual saving in dollars and cents through preservative treatment, a fence post such as was mentioned at the beginning might serve as one example. The post is of loblolly pine, and costs, untreated, about 8 cents, or, including the cost of setting, 14 cents. It lasts about two years. Compounding interest at 5 per cent, the annual charge of such a post is 7.53 cents; that is, it costs 7.53 cents a year to keep the post in service. Preservative treatment costing 10 cents will increase its length of life to about eighteen years. In this case the total cost of the post, set, is 24 cents, which compounded at 5 per cent, gives an annual charge of 2.04 cents. Thus the saving due to treatment is 5.49 cents a year. Assuming that there are 200 posts per mile, there is a saving each year for every mile of fence of a sum equivalent to the interest on $219.60.

In the same way preservative treatment will increase the length of life of a loblolly pine railroad tie from five years to twelve years and will reduce the annual charge from 11.52 cents to 9.48 cents, which amounts to a saving of $58.75 per mile.

It is estimated that 150,000 acres are required each year to grow timber for the anthracite coal mines alone. The average life of an untreated mine prop is not more than three years. By proper preservative treatment it can be prolonged by many times this figure. Telephone and telegraph poles, which in ten or twelve years, or even less, decay so badly at the ground line that they have to be removed, can, by a simple treatment of their butts, be made to last twenty or twenty-five years. Sap shingles, which are almost valueless in their natural state, can easily be treated and made to outlast even painted shingles of the most decay-resistant woods. Thousands of dollars are lost every year by the so-called "bluing" of freshly sawed sapwood lumber. This can be prevented by proper treatment, and at a cost so small as to put it within the reach of the smallest operator.

In the South the cheap and abundant loblolly pine, one of the easiest of all woods to treat, can by proper preparation be made to take the place of the high-grade longleaf pine for many purposes. Black and tupelo gums and other little-used woods have a new and increasing importance because of the possibility of preserving them from decay at small cost. In the Northeastern and Lake States are tamarack, hemlock, beech, birch, and maple, and the red and black oaks, all of which by proper treatment may help to replace the fast-diminishing white oak and cedar. In the States of the Mississippi Valley the pressing fence-post problem may be greatly relieved by treating such species as cottonwood, willow, and hackberry.

Circular 139 of the Forest Service, "A Primer of Wood Preservation," tells in simple terms what decay is and how it can be retarded, describes briefly certain preservatives and processes, gives examples of the saving in dollars and cents, and tells what wood preservation can do in the future. The circular can be had free upon application to the Forester, Forest Service, Washington, D. C.

WARES OF A WASTED RACE.

By Clem. A. Copeland.

THE Diversion Division of the Department of Archeological Engineering of the "Journal" listened to a story of Western life—a story of long ago. And through the blue haze of a panatella, while the Pullman smoker was speeding away a thousand miles in a day, the story was told of how the Apaches and the Navajos, perhaps a hundred generations ago, gazing over the distant mountains saw visions of a new and warmer clime. From the bleak plains of Canada they journeyed a thousand miles, but alas, not in a single day, for months of patient, dogged travel were passed in reaching the weird, sear plains of the arid zone, where the Colorado and the Rio Grande lay steaming in the sun.

So the warlike Navajos, the Pimas and the Apaches drove the other tribes away, as the story goes, these leaving graves in their front yards filled with vases, the implements of their craft and the bones of an ancient civilization. Were those who fled before the invaders the Aztecs or a more ancient race? We show in a photo below, the face of one of these aborigines; but, alas, he is silent and will not answer.

Thus, out on the sage brush wastes of New Mexico, to the north of the Santa Fe, lie the foundations of stone and sun-baked mud, this old race, scarcely discernible, except to the practiced eye of the Navajo guide, who knows where to dig for the bones and handiwork of these ancients, of whom there are even no traditions in the lore of the tribes now there. Here is a vase made by spirally winding strips of mud pressed to adherence with the thumb nail and even the imprint of the skin of the thumb, baked into their flinty substance.

We show in these pages a rare collection made by Mr. Orcutt, Geological Engineer for the Union Oil Company, from quite widely-separated points in this section. The swallow-nest vases just talked of are easily picked out from the others, which show a marked similarity of figuring, with the exception of the ollas, or cooking vessels, which are quite like those of nowadays. To the "swallow nests" or "thumb nail" pottery is ascribed the greatest antiquity. The almost Grecian designs and the artistic shapes, rather "nouvoux" in style, together with an excellent mechanical workmanship, merit a lingering interest. One is forced to admit that the art and workmanship is superior to that of latter-day arrivals.

The vast area from Colorado to Central Mexico contains similar wares of a plentiful population, evidently not the predecessors of the tribes now inhabiting the great Southwest. With the ruins left behind no implements of war are found; indicative of a peaceful people of a single tribe; for division would mean tribal wars.

In the neighborhood of the dim ruins are dried-up basins once filled with water, the stone steps still standing, stranded in the glaring sun, which led the way down to the water's edge; and there are abandoned irrigating systems, too, telling of a progressive race, and a once fertile land.

Near by is a cliffed mesa, "Battle Mesa," as it is called, its perpendicular cliffs serving as a barrier to the foe save at one end where stone steps lead to the top. Here perchance the Apaches and Navajos laid siege and entrapped the peaceful people.

WARES OF A WASTED RACE. BATTLE MESA IN THE WASTES OF NEW MEXICO.
PURISSIMA MEMENTO. SILENT MAN FROM NOWHERE. A CAVE OF THE CLIFF-DWELLERS.

Many believe that the Cave Dwellers were these selfsame people, driven to "cyclone cellars" of safety by the invaders. It is also believed by some that the Hopi Indians—the interesting builders of the first seven-story skyscrapers in pueblo-land—are the descendants of those who fashioned these wares—the hinted race from where? The present Pueblo Indians, or the Hopis, it seems, have settled in, and to a certain extent remodeled the old villages which Coronado found silent and deserted three hundred and seventy years ago.

Mr. Orcutt has, also, in his collection of Indian craft, a mortar found buried in the Santa Inez Valley of California, which has some 600 pounds to its credit, and must have ground meal for quite a tribe, while the Mission bells called them to Purissima service. From its esconded rest it has been brought to the busy city, and a modern sun beams in the bowl.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MARCH 14, 1908 No. 11

EDITORIAL.

APPLICATION OF ELECTRICITY TO METALLURGY.

The application of electricity to the refining of gold and silver bullion, as described in this issue, is but one utilization of the many results of long, painstaking efforts on the part of indomitable workers in the chemical laboratory. Such a process is not like a bumble-bee, biggest when born, but resembles the growth of a man from infancy to maturity. It is a matter of slow development. By its novelty, and because of its great potentialities, electro-chemistry has attracted many investigators, whose work is just now being applied practically. The various industries that have grown from the nucleal manufacture of aluminum at Niagara Falls, Canadian and Californian experiments in electric iron smelting, and the large electrolytic copper refineries, are examples familiar to American readers. French, German and Italian researches have extended even further, and will shortly have practical exemplification in this country.

To list these applications would be to catalogue the mineral products of economic importance, for there is no substance that cannot be either decomposed, melted or volatilized by electricity. Its energy is available for either chemical, mechanical or heating action, giving perfectly controlled gradation from the feeblest efforts to the most intense manifestations of each type. This makes an ideal reagent for analysis and synthesis requiring delicacy of chemical manipulation, and accuracy of elemental proportion, combined with great heat not easily obtained otherwise. All electro-chemical operations are performed either by the analytical properties of an electric current passing through an electrolyte or by the heat produced when a current of electricity passes through a conductor which is not an electrolyte.

In the laboratory the main objection to the use of electrolytic analysis has been the long time required to complete the reaction, whereas the same separation can be accomplished in less time by ordinary chemical means. Recent investigations have partially removed this difficulty by employing mercury cathodes. Yet the advantages of cleanliness, accuracy and simplicity, especially where no other chemicals are to be added, counterbalance this objection, so that electro-chemical analysis is fast finding favor with chemists.

But, due to the requirements of a materialistic world, demanding dividends on dollars invested, the industrial application is getting far more attention. This is necessarily based on previous research work, and the latter cannot be neglected without serious injury to the commercial side. Theory and experiment precede the processes required by Progress, and supported by Capital. Few realize how important a factor electricity has become in our industrial welfare based on mineral resources. The Geological Survey's report on the Mineral Resources of the United States is subdivided in six parts devoted respectively to metals, fuels, structural, abrasive and chemical materials, and miscellaneous. Of these natural resources fuel has heretofore been the most necessary in converting the others to the use of man, but so prodigal has been its use that the supply is being rapidly exhausted. Already this deficiency in power and heat has been partly filled by hydraulically generated electricity, which may yet solve the fuel problem.

Of the metals there is not one for which an electric smelting or refining process has not been devised. Aluminum is produced solely by its action, its lower cost having put the old crucible method out of competition, and caused the price to drop from fifteen dollars to thirty-five cents per pound. Nearly three-fourths of the copper produced in this country is refined electrolytically, and such is found to have a higher conductivity, but lower tensile strength. Incidentally, this furnishes nearly 6 per cent of the total gold and more than 25 per cent of the total silver production. The large amount of these metals used in coinage is also refined electrolytically. The Betts electrolytic process of lead reduction has been installed in two of the latest and most modern refineries —The United States Metal Refining Co., and the Canadian Metals Co. The latter is also producing antimony. In separating zinc from associated iron sulphide, electrostatic and electro-magnetic concentrating machines are used, and a smaller plant for the electro-thermal smelting of zinc ores has been erected at Nelson, B. C.

Electric smelting of iron ore has not yet proven commercially successful on a large scale in competition with the blast furnace in America, through Norway's special ores are being treated by this process. Where electricity can be developed at a cost of $10.00 per electrical horsepower year, Harbord has estimated that it is on a par with coke at $7.00 per ton. It would be practical for ore carrying titanium or other substances that are hard to treat in the blast furnace, and is being successfully applied to the manufacture of high grade steels and ferro-alloys, such as manganese, chromium, tungsten, nickel, vanadium, molybdenum and titanium. Experiments are being made in California for treating ores of mercury, and tin is also being refined in this way.

Electro-chemistry has little application in treating the so-called structural materials, though many of these are largely used for electrical purposes. Artificial abrasives, including carborundum and alundum, produced in the electric furnace, make up one-third of the total used. Of the miscellaneous materials, the manufacture of phosphorus from phosphori rock in an electric furnace, and the production of artificial graphite, are the most notable, although the electromagnetic concentration of monazite and zircon promise some success. Various gems, including the diamond, sapphire and ruby, have been made in an electric furnace, but with the exception of the latter, have not replaced Nature's product.

In Europe the atmospheric fixation of nitrogen is being applied to calcium cyanamide and nitric acid, and in this country calcium carbide, made in the electric furnace, is now universally used.

We have briefly indicated the extensive uses of electricity in the industrial scale, but when we consider that every process mentioned has been practically developed in the last two decades, we may well be sanguine of electricity's conquest over heretofore refractory ores, when its great power is guided by the experience already gained. But our enthusiasm for its possibilities must not override prudent recognition of its limitations. For while it can apparently accomplish all things there are yet other powers that can do some of these things much cheaper. These are often available where electricity is not, and will occupy the greater part of the field until electricity can be produced for a small fraction of its present price.

TRADE NOTICE.

The Westinghouse Electric & Mfg. Co. have moved to permanent quarters at 165 Second St., San Francisco, and invite their friends to inspect the same. This new and commodious location gives every facility for the rapid handling of orders, insuring satisfaction to buyers.

TRADE CATALOGUES.

Bulletin No. 32, from the Warren Electric Mfg. Co., of Sandusky, Ohio, gives an account of electric welding in machines made by them. It contains much interesting and valuable information on rapid butt welding.

N. E. L. A. CONVENTION, 1908.

Thursday, May 21st, has been set aside by President Farrand as Commercial Day for the National Electric Light Association's Convention. The committee, composed of C. W. Lee, J. Robert Crouse, John F. Gilchrist, George Williams, Howard K. Mohr and Frank B. Rae, Jr., has been busily engaged in preparing the program for the day. It is the purpose of the committee to have the papers which will be presented consume the least possible time; the major portion of the two sessions being devoted to discussion. The following is the program as outlined by the committee:

Commercial Day Program.

(1)—Special Feature: Relationship between the Engineering and Commercial Departments by a prominent electrical engineer.

(2)—Preparation for a Campaign: (a) Field Work and Other Essentials; (b) Analysis of Customers' Accounts; (c) Proportion of Lamp Equivalents Lost to Lamps Connected, showing percentage in cities of varied population; (d) Policy of Handling Complaints; (e) Policy of Handling Collections.

(3)—The Contract Agent and the Representative: (a) The Contract Agent—His Possibilities; (b) The District Representative—His Possibilities; (c) The Special Representative—1. The Sign Expert; 2. The Power Expert; 3. The Woman Representative. (d) Solicitors' Meetings—Their Objects.

(4)—The Display Room: (a) Appointments and Methods; (b) Value of Special Demonstrations; (c) Value of Electrical and Food Show Exhibits.

(5)—Advertising: (a) What is Being Done; (b) Why; (c) Results.

(6)—Publicity: (a) Methods to Create Proper Public Sentiment; (b) Dormant Publicity Opportunities of Lighting Companies.

(7)—Creating Demands for Electricity: (a) The Creative Principle; (b) The Notable Examples; (c) Stereopticon Talk Upon Outline and Sign Lighting—showing progress in large and small cities.

(8)—Evolution of New Business Building: (a) Examples of Central Stations that have continued methods during depression; (b) Strong Plea for Up-keep of Commercial Departments and Advertising; (c) Opportunities for Creating business along existing lines.

(9)—The Electrical Contractor—Symposium: (a) What He is Doing to Assist in Creating Greater Demands for Electricity; (b) Specific Examples.

(10)—Co-operative Commercialism, by J. Robert Crouse.

(11)—Illuminating Engineering as a Commercial Factor (illustrated), by V. R. Lansingh.

(12)—Report of Committee on Solicitors' Hand-Book. Award of prizes offered by Co-operative Electrical Development Association.

PERSONAL.

Bertram M. Downs, secretary of the Brookfield Glass Company of 218 Broadway, New York City, is in San Francisco.

Mr. C. E. Winchell, Los Angeles manager for H. W. Johns-Manville Co., has been in San Francisco during the past week.

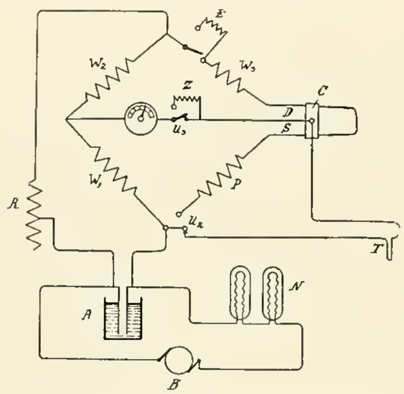
Mr. J. E. McGillivery, Western representative of the American Electric Telephone Company, of Chicago, is in San Francisco, to establish a local office. This firm has just put in a 3,000-line, central-energy board at Topeka, Kansas.

Mr. J. R. Allen, leading contractor of San Diego, California, was at the St. Francis last week. Mr. Allen was formerly in business in San Francisco. This is his first visit since the fire, and he was loud in his praise of the enterprise shown in the rapid rebuilding and high class of structures.

PATENTS

ELECTRICAL SYSTEM OF MEASURING TEMPERATURES. 880,074. Ernest Haagn, Hanau, Germany, assignor to firm of W. C. Heraeus, Hanau, Germany.

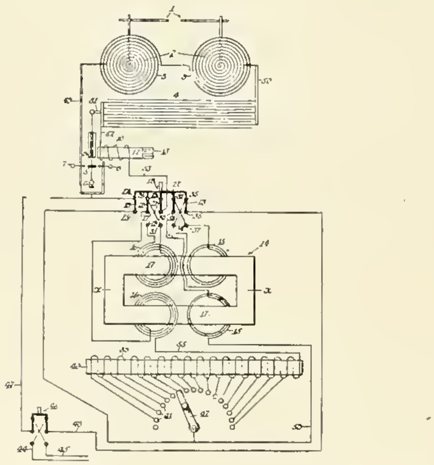
In a system of electrically measuring temperatures, the combination with a Wheatstone bridge, of a resistance thermometer included in one of the branches of said bridge



a galvanometer included in the central branch of the bridge and having a scale indicating the variations of the temperature of said resistance thermometer, an iron resistance connected in series with the bridge, and a polarization cell connected in shunt with the bridge.

HIGH-FREQUENCY DISCHARGE APPARATUS. 880,046. James E. Seeley, Los Angeles, Cal., assignor to Synchronous Static Company, Los Angeles, Cal.

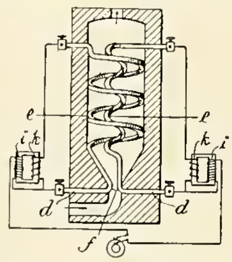
A high-frequency discharge apparatus comprising a discharge circuit, a charging circuit, a supply circuit, an induction apparatus having a plurality of windings, means for connecting one of said windings in the supply circuit



and the other of said windings in the charging circuit, said induction device having a closed circuit core, and switch means for connecting the coils on said core to energize the core on closed magnetic circuit or in open magnetic circuits in opposite directions.

METHOD OF TREATING GASES AND GAS MIXTURES BY MEANS OF VOLTAIC ARCS. 880,037. Albert J. Petersson, Alby, Sweden.

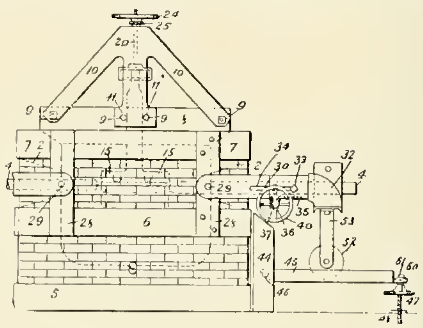
The method of treating gases by means of voltaic arcs which consists in leading gases through a furnace chamber, creating the said arcs between electrodes in the said furnace chamber and creating electrodynamic forces by means of



electric currents of greater intensity than that of the current creating the arcs and induced by the last-mentioned current for displacing the arcs.

ELECTRIC-ARC FURNACE. 880,338. Sidney D. Spence, Chattanooga, Tenn.

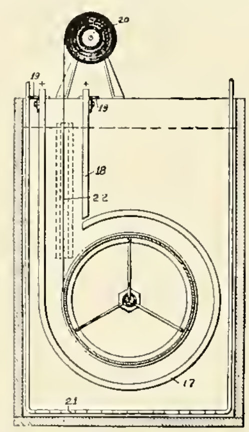
An electric arc furnace having a removable cover, longitudinally disposed tie and reinforcing rods extending through said cover, upwardly extending brackets at the



ends of the cover and to which the ends of the said rods are attached, a fixed supporting element connecting the said brackets and disposed above the cover, a movable bar, means connecting said supporting element and said supporting bar, and screws to adjust the latter, and electrodes carried by and adjustable with said supporting bar.

PROCESS OF PRODUCING VERY THIN SHEET METAL. 880,484. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J.

An improved process for producing metallic sheets or foils, which consists in electrolytically depositing a thin



metal film on a polished surface of an aluminum-copper alloy in which the percentage of copper largely predominates, and in finally stripping the film from said cathode below the surface of the bath.

INDUSTRIAL

KOERTING OIL FIRING.

The Koerting patent oil firing system eliminates the necessity of steam or air for atomizing purposes. The oil is super-heated and at the same time the pressure is kept high enough to prevent gasifying or carbonization. When it is forced through the centrifugal spray nozzle the oil flashes into the finest atoms and mixes with the air in the combustion chamber.

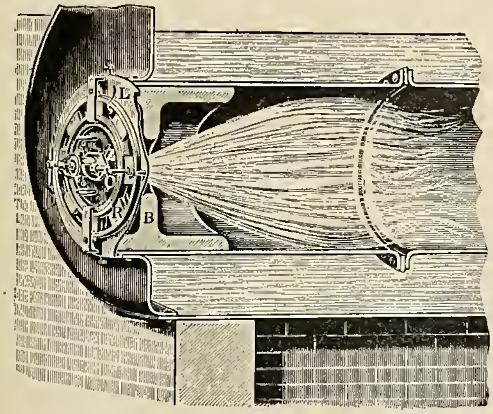


FIG. 1.

It flows from the supply tank to a central pumping outfit in which it is heated, filtered and pumped to a second heater, where it is raised to 220 or 290 degrees Fahrenheit, considerably above its flash point at atmospheric pressure. From the second heater it is forced through the spray nozzle into the combustion chamber. The steam used for pumping and heating is condensed and returned to the boiler feed.

Fig. 1 shows the centrifugal spray nozzle, the air admission registers and the method of spraying. If there is steam in the boiler it is carried to the heaters and the pump started to circulate the oil through the circular pipe until it is hot enough. Meanwhile all gases in the fire-room are drawn out by putting on full draft, thus preventing danger of explosion. The oil is ignited from the spray nozzle after the ring-pipe has been shut off.

If there is no steam pressure on the boiler, then the warming up arrangement should be started. When starting the oil firing plant, smoke will appear until the walls of the fire-room are heated to a temperature that the flame is not cooled off. When stopping the plant, the air admission must be shut off so that the boilers do not cool too much.

The spray nozzles are constructed for easy access and thorough protection against clogging. The casing (or nest) installed in front of the boilers, holds one, two or four nozzles, according to the evaporation required. Each nozzle is protected by a strainer and each spiral may be removed and exchanged without disconnecting the nest from the boiler plate, avoiding interruptions from obstructions. A cock is installed on each nozzle, and one thermometer and pressure gauge placed on each boiler in the oil line. The pipe line to the nozzles is arranged circular for the purpose of heating the liquid fuel to the correct temperature by pumping the oil over and over, nozzles being shut off.

Either circular slide registers or cylindrical air admission slides are used to caary the air to the furnace- The last construction has the advantage of protecting the fireman from the radiant heat; but it takes a little more room than the circular register. The registers properly regulate the amount of combustion air, while the brick lining of the boilers serves the purpose to bring the air in the correct way to the oil and prevent the flame from coming in direct contact with the walls of the boiler, as this reduces the heat of the flames so much that the carbon does not burn.

Fig. 2 illustrates oil firing on marine boilers and Fig. 3 on locomotives. In the case of marine type boilers, the full section of the furnace is used, the grate being unnecessary. Therefore there is a gain in heating surface. The heating and resulting expansion is equal, and all the water surrounding the flue is correspondingly heated. The short fireclay lining in the furnace serves as a protection against the intense temperature of the oil flame, and enables the boiler to be readily set to work after a short interruption, as no after-heating is necessary; the oil ignites on the incandescent fireclay.

One pound of fuel oil does the same work, in evaporating the water in the boilers, as 1.4 pounds of coal, or 4.2 barrels of fuel oil are equal to one ton of coal. One man only is necessary in the boiler-room. The conveying of fuel to the boiler is accomplished by the system. The larger the plant the greater the saving. Sixteen hundred pounds of fuel oil is equivalent in heating value to one ton, or 2240 pounds of coal.

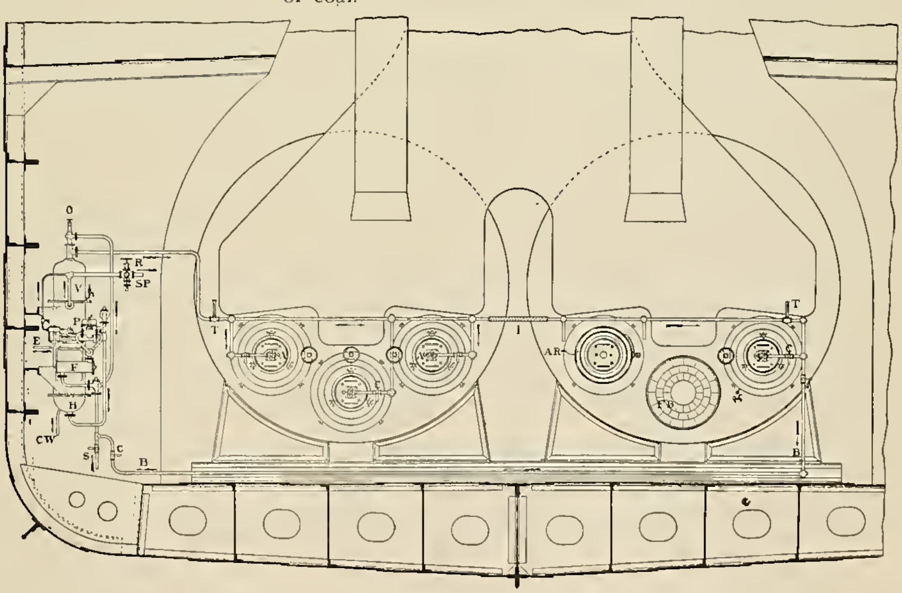


FIG. 2.

The application of the centrifugal sprayer obviates the defects of the steam-jet system, and secures several important advantages. In spraying petroleum, raw naphtha, mazut, astatki, etc., by means of steam jets, a certain portion of the heating value of the fuel is lost, as the steam has to be raised to the furnace temperature, and, being used for spraying, is lost to the boiler. In the case of marine boilers

this loss is especially disadvantageous, as the steam used for spraying represents a loss of water which has to be replaced. This loss is often 100 per cent or even more than the weight of oil sprayers.

Compressed air systems are expensive to run on account of power required and the amount of wear and tear

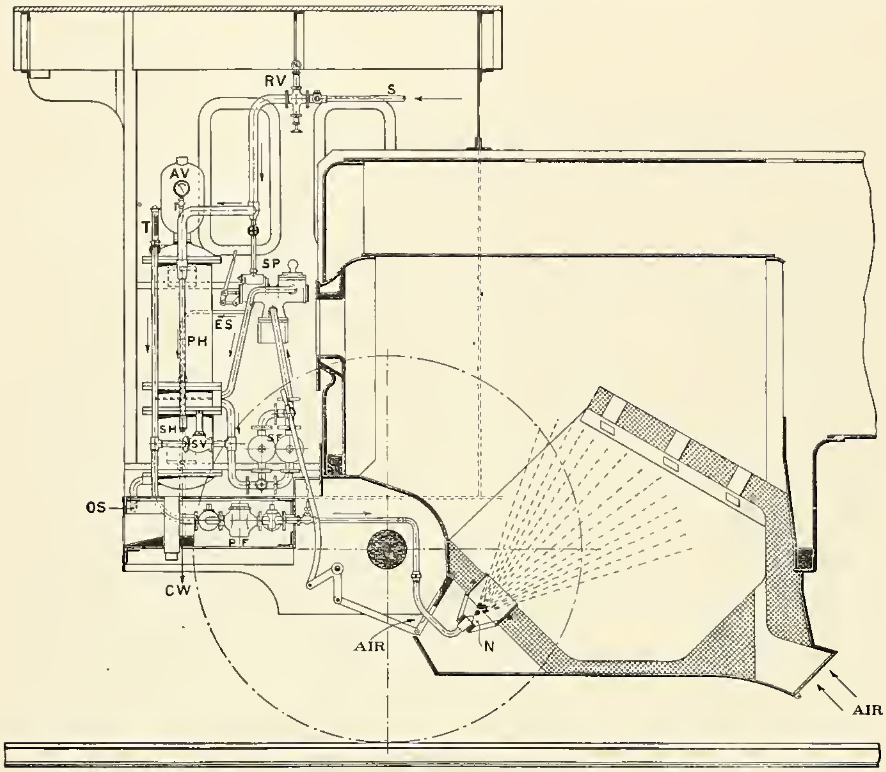


FIG. 3.

resulting from the intense flames. The power required to run a Koerting system can be easily estimated as follows: To move 100 pounds of oil under a pressure of seventy-five pounds, requires only 0.8 pounds of steam. The steam required for two heaters is approximately eight pounds steam per 100 pounds of oil. Figuring one pound of oil to evaporate 13 pounds of steam would mean 100 pounds of oil creates 13000 pounds steam. On this system according to above, ten pounds steam would equal $\frac{7}{10}$ per cent of steam developed. Steam-jet burners, or burners working by compressed air, use about fifteen to twenty-five per cent of the steam developed for spraying the oil.

The centrifugal sprayers give effective atomizing, therefore high efficiency; smokeless combustion, reliability in working, no noise, no waste—all water returns to the boiler; equable heating of upper and lower parts of furnace in marine, Lancashire or Cornish boilers; simplicity of air regulation, ease in replacing the burner by a spare nozzle, no intense local flames, increase of heating surface, minimum attendance required, easy and slow firing at start.

The Benjamin Electric Manufacturing Co., of Chicago, have received notice from the National Board of Underwriters that their new No. 903 Attachment Plug has been approved. On account of a number of unique features which this device embodies, it has met with unusual favor with the trade. The manufacturers have been compelled to take special measures in order to meet the rapidly growing demand. The fact that it is now National Code Standard removes the last obstacle in the way of its final acceptance. Descriptive circular matter will be sent on application. The company has an office at 656 Howard Street, San Francisco.

A NEW HOLOPHANE STREET LIGHTING REFLECTOR.

The Holophane Company announces a new street lighting reflector for incandescent lamps which is without doubt one of the most remarkable developments of the Holophane System yet offered.

This reflector is designed with a series of exterior vertical reflecting prisms on the side which faces the sidewalk and an interior set of carefully calculated diffusing prisms on the side facing the street. This combination gives an irregular distribution of light in the horizontal plane.

When the reflector is properly placed at about the curb line, it throws the light with great intensity up and down the street and more moderately across the street, and when "staggered" at proper distances along the curb, gives practically uniform distribution of light on both roadway and sidewalk.

The vertical distribution is equally satisfactory, a unit consisting of this reflector with 40-candlepower Gem lamp, giving about 20 candles directly beneath the light while the intensity at 10 degrees below horizontal is over 80 candlepower.

Other practical advantages are: It is not easily broken, and so serves to protect the lamp. It gives practically double the useful illumination of the bare lamps. It is not materially affected by dust, all prisms being vertical. With modern high-efficiency lamps it enables the electric lighting company to compete with small gas lamps on practically equal price basis. It can be intalled inside opal, frosted or other globes where decorative effects are desired.

"DOSSERT" CONNECTORS RECENTLY ORDERED FOR NEW YORK CITY.

Dossert & Company, of New York City, have received what is probably the largest order for terminal lugs ever used on a single installation in this country. The material is for use in the wiring of the immense terminal buildings at Cortlandt, Church and Fulton Streets, New York, of the Hudson & Manhattan Railway Company, operating the tunnels under the Hudson River, which have just been opened to the public. These terminals are all of the Dossert solderless type, comprising front connection, back connection, angle swivel lugs, and range in size from 2,000,000 C. M., to No. 4 cable. Part of the order comes from the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and is for lugs to be used on their fuse blocks, enclosed type, 61 to 600 amperes. Approximately 1,000 Dossert solderless lugs are required for the switchboards and panelboards of these great twin buildings. F. A. Lawson & Co., Pacific Coast agents, 209 Monadnock Building, San Francisco, Cal.

NEWS NOTES

WATERWORKS.

San Bernardino, Cal.—Foreman Rickman, who is in charge of the erection of the water treating plants, has gone to Keenbrook to start work on a smaller one than is installed in this city.

San Francisco, Cal.—Water rates for the year beginning July 1st came before the Board of Supervisors at the last meeting in two committee reports—Johnston and Murphy advocating the re-enactment of the 1903 rates, with the exception that the city should increase its own allowance to the Spring Valley Water Company to $150,000. Mr. McAllister submitted a minority report, in which he advocated giving a fifteen per cent increase to the company over the 1902 rates. Both reports based their charges upon the theory that the company was entitled to a five per cent net income on the value of the plant actually in use.

Oakland, Cal.—The city of Oakland will receive bids on March 18th for the pumping machinery to be used in the construction of its auxiliary high-pressure pumping and salt water distributing system as a further protection against fire. The plant will consist of two gas engines geared to two centrifugal pumps, together with an auxiliary gas engine, pump and motor, air compressor and storage tanks, accumulator and other appurtenances. The plant is to be located on the west shore of Lake Merritt. The combined capacity it to be 2,000 gallons of salt water per minute, raised against a head of 200 pounds pressure at the discharge and of the pump, the maximum suction lift being seven feet above the floor. Each engine is expected to develop 250 horsepower and the pumps must have an individual capacity of 1000 gallons per minute. An auxiliary pumping plant will be furnished and used for maintaining a pressure of fifty pounds in the force main and distributing system while the main pumps are not in operation. It will have a capacity of fifteen gallons per minute. It is required that one pump shall deliver its full capacity of water at the specified head within two minutes after starting, and that both pumps shall be delivering their full combined capacity within five minutes of the beginning of the test.

TRANSPORTATION.

San Francisco, Cal.—The Geary road suit in relation to the $720,000 sought to be set aside for a municipal railway in the budget of last June has been dropped. This leaves $395,000 in the city treasury without a purpose.

San Diego, Cal.—The Board of Public Works has issued an order compelling the San Diego Electric, the Los Angeles & San Diego Beach Electric and the South Park & East Side Electric Railroad Companies to fill in between their tracks on both paved and graded streets.

Chico, Cal.—Twenty-five acres have been transferred to the Northern Electric Company by the Valley Syndicate for the future establishment by the Northern Electric Company of freight yards immediately south of the Chico car shops. Between six and eight miles of parallel sidetracks will eventually be constructed, after the company's finances are such that the proposed extensions can be constructed.

Long Beach, Cal.—F. A. Crowe has sold the franchise which he recently purchased from the city to George H. Bixby, who is said to be acting for the Pacific Electric Company. They are important franchises, one being for a line the entire length of Seventh Street within the city limits, the other giving rights to build and operate a road along Pine Avenue, between Sixth and Fourteenth Streets.

Oakland, Cal.—Representatives of the Oakland Carmen's Union, and the Oakland Traction Company and the Key Route system, have signed an agreement to govern the wage scale of the carmen for twelve months, commencing March 1st. The carmen decided that the old scale was satisfactory and the executive committee was authorized to sign a new agreement on the same terms as the old one. The wage scale, which it is agreed shall continue, and which bears the distinction of being the highest wage scale for street car employes in the United States, provides for the payment of forty cents per hour to motormen and conductors of the Oakland Traction lines and to the collectors of the Key Route lines. The motormen and conductors of the Key Route are paid from thirty-eight to forty-two cents per hour.

OIL.

Carson, Nev.—Treasurer Brown, of Mono County, Cal., who is now in this city, announces that a Los Angeles bank has agreed to finance a pipe line from Mono Lake to Goldfield to carry oil from the new fields there to the southern mining camp. An expenditure of $750,000 is necessary to carry the scheme to completion.

Santa Barbara, Cal.—The Palmer Oil Company has closed a contract for 2,000,000 barrels of oil to be delivered in the next three years at fifty cents a barrel at the well. The Palmer Oil Company has completed arrangements for the construction of an eight-inch pipe line from its wells to the pipe lines now in the Santa Maria field.

Rhyolite, Nev.—The Nevada-Utah Oil & Pipe Line Company has been organized to develop four sections of oil land in Washington County, the officers being O. D. Van Buskirk, president and general manager; Clay Tallman, attorney; Geo. B. Keenan, secretary; Geo. B. Davis, cashier. The main office is at Oakland. In addition to drilling for oil, the company will establish a pipe line to some point convenient to transportation.

FINANCIAL.

San Francisco, Cal.—Assessment No. 7 of 2 cents per share, delinquent March 24th, sale day April 14th, has been levied on the Williams Oil Company.

Pasadena, Cal.—Acting on the advice of Attorneys Dillon & Hubbard, Mayor Early and the Council will resubmit the issue of $1,000,000 in bonds for the purchase of three water companies.

Tucson, Ariz.—The $300,000 Tucson bond bill has passed the House of Representatives and the Senate and has been signed by President Roosevelt. The amount set aside for the improvement of water mains will be $26,000; for fire department, $25,000, and for city hall, $15,000.

Santa Barbara, Cal.—A resolution has been adopted by the Mayor and City Council for issuing bonds in the amount of $36,000 for continuing the construction of municipal improvements. The work will include the building of a storage reservoir and impounding dam.

Redding, Cal.—The suit of the Battle Creek Power Company against the Pacific Power Company and others to condemn twelve acres of land on Battle Creek for a reservoir site ended last week, after three weeks in court, the jury giving the Battle Creek Company the land sought, but requiring $32,500 as damages. The land is worthless except for the water rights going with it. The Battle Creek Company's right to 18,000 inches of water was confirmed.

San Francisco, Cal.—President Patrick Calroun, of the United Railroads Co., has issued for the information of the bond and stockholders of the street railroad corporation a report showing the gross earnings of the company for December last. They amount to $481,285, as compared with $562,200 for the same month of the preceding year, or a decrease of $80,915. This is the fifth monthly report of gross receipts made by Pres. Calhoun since the carmen's strike, which began on Sunday, May 5th, 1907, and continued until late in that year. These reports contain no mention of operating and other expenditures. The five monthly statements of gross receipts are as follows: June, 1907, $152,126; 1906, $448,455; decrease, $296,329; August, 1907, $317,769; 1906, $429,311; decrease, $11,542; September, 1907, $367,220; 1906, $425,199; decrease, $57,979; November, 1907, $449,732; 1906, $536,166; decrease, $96,428; December, 1907, $481,285; 1906, $562,200; decrease, $80,915.

INCORPORATIONS.

San Francisco, Cal.—The Fledge-Mohr Electric Appliance Company has been incorporated with a capital stock of $100,000 by L. P. Degan, A. C. Fiege and Otto H. Mohr.

San Francisco, Cal.—The Result Oil Company has been incorporated with a capital stock of $25,000 by P. E. Bowles, F. W. McNear, O. D. Jacobs, E. J. Broberg and A. A. Griffin.

Santa Rosa, Cal.—Articles of incorporation have been filed by the Chileno Valley Telephone Company, with a capital stock of $5,000. The directors are M. De Martin, Chas. Martin, A. Bloom, H. Juhl and J. Schobeda.

Santa Ana, Cal.—Articles of incorporation of the Juergo Land & Water Company have been filed. The capital stock is $10,000 and headquarters are at Los Patos station on the Pacific Electric line. The directors are Owen McAleer, R. C. P. Smith, Lester L. Robinson, W. J. Cullon and Byron Oliver.

San Frfancisco, Cal.—The Clear Lake Power & Irrigation Company has been incorporated with a capital stock of $10,000,000. The company has been formed to bring electric power to San Francisco for all purposes and to irrigate 200,000 acres of land in Yolo County. The names of the capitalists behind the project are kept secret by the counsel, Charles S. Wheeler.

Oakland, Cal.—The consolidation of the San Francisco, Oakland & San Jose Railway, known as the Key Route, and the San Francisco & Bay Counties Railway, of which articles of incorporation were recently filed, has been effected. The purpose of the consolidation, as outlined in the articles reincorporating the two companies under the name of San Francisco, Oakland & San Jose Consolidated Railway, is to operate a railway along the eastern side of San Francisco Bay to San Jose in conjunction with the present Key Route service, and construct a sub-way to Goat Island. The latter project is to be carried out as "soon as same can be done under the State laws." It will begin at the pier head line and bring up at some point on the island. A railway service will be maintained in the tunnel, which will also accommodate a telephone and telegraph line. The capital stock of the new consolidation is given as $7,750,000, all of which has been subscribed. The directors are: F. M. Smith, F. C. Havens, A. E. Heron, H. Wadsworth and Dennis Searles, all of Oakland.

TELEPHONES.

Independence, Ore.—Geo. E. Waggoner, of the Home Telephone Co., was up from Portland Friday trying to get an organization started for the installing of an independent telephone system here to connect with the Home Company.

North Yakima, Wash.—Messrs. Fullerton, of San Francisco, and Fleager, of Seattle, construction superintendents of the telephone system of the Pacific Coast States, were in North Yakima recently and walked over the entire system in this locality. As a result of their visit it is believed that the construction work on the west side, which was expected to be undertaken about June, will be begun at a much earlier date. The work there is to be the erection of what is termed a "backbone" for the service, running direct west through the city and beyond to the limits of building construction, the various service lines to radiate from it.

Billings, Mont.—J. Nevin Perry, manager of the Billings Mutual Telephone Company, returned from Fishtail and Absarokee, where he completed arrangements with the Stillwater Co-operative Telephone Company to connect with the Mutual Telephone Company at the Columbus exchange. The arrangement will extend the service of the Billings Mutual Telephone Company to all the farms and towns in the Stillwater and Rosebud valleys. It will give the residents there connection with the Billings telephone exchange and will give subscribers of the Mutual Company in Billings and the district adjacent thereto connection with the phones on the Stillwater Co-operative Telephone Company's lines.

ILLUMINATION.

Escondido.—A special election will be held to vote upon the proposition of installing an electric light plant.

Ocean Park, Cal.—E. A. Wilson & Co., of Santa Monica, have been awarded the contract for furnishing new lamp posts for Ocean Front Walk, for $2,475. Wiring will be done by the same company for $2,878.

San Diego, Cal.—A tax will be levied on the property owners on Sixth Street for the erection of ornamental lighting posts. The erection will cost $5,490. When the money has been collected the Board of Works will advertise for contracts.

Washington.—Contracts have been awarded for two fifty-horse-power gas engines and apparatus to make gas from crude oil at a total cost of $8,000 for the Yuma irrigation project. The plant is to be in operation in ninety days and it is expected that 10,000 acres near Yuma will be irrigated by pumps during 1908.

Compton, Cal.—Representatives of the Edison Company of Los Angeles have been here with a proposition to install a gas plant. Their proposition is build a plant between this place and Watts, and furnish the two places with gas at the rate of $1.50 per 1000. They ask Compton to guarantee $3,000 in stock when the plant is erected and started operating.

Benson, Ariz.—President John Mets wrote the manager of the Luzoline Gas Company that the company would lay pipe not later than the 15th of next month. At the present time the company is manufacturing the fluid from which the gas is made in Tucson and Los Angeles, but if the company can get the business in Benson they will erect a plant here.

Los Angeles, Cal.—Ground has been broken for the plant of the Huntington Park Gas & Electric Company, and as soon as excavations are completed the building will begin. The company has two acres of land in the northwest corner of block 1 at Slauson Avenue and Middleton Street. The machinery for the plant has been purchased and contracts let for the work. The incorporators are F. M. De La Matyr, J. J. Curren and E. T. Kepkfeld.

Sacramento, Cal.—The Sacramento Natural Gas Company is sparring for time in the matter of paying to the city the three per cent tax on its gross receipts as provided in its franchise, in paying which it has been delinquent for the past five years. The matter was called to the attention of the Trustees and City Collector Spaulding several weeks ago. Mr. Spaulding immediately notified the company, but H. C. Keyes, the former manager, is in Europe, and his son, Homer F. Keyes, who was acting as manager in his absence, asked for time in order to send a cablegram to his father. A message was sent to Mr. Keyes, but up to the present time no answer has been received. The amount due the city from the company will probably be somewhere between $4,000 and $6,000.

LIGHT AND POWER.

Helena, Mont.—The highest dam anywhere in the Western country will be erected across the Missouri River a few miles from Wolf Creek on the site of the power plant of the Capitol City Power Company. M. H. Gerry, Jr., is general manager. The dam will be 117 feet high, built of concrete and steel, and will back the water up a distance of eighteen miles. The plant will generate 30,000 horse-power.

Malad, Idaho.—Articles of incorporation of the Malad Power Company have just been filed with the Secretary of State. The company is capitalized at $1,000,000. Its purpose is to put in a power plant to utilize 800 second feet of water which it takes over from the King Hill Irrigation & Power Company to irrigate a large amount of Carey act lands soon to be opened up in that section.

Tillamook, Ore.—The dynamos of the Tillamook electric light plant will have a capacity of 2000 lights, about twice what they expect to sell. Boiler and engine will be new and of the latest designs. The plant will be temporarily located on the slough between Long's mill and the Pacific Navigation Company's freight sheds. They expect to spend in the neighborhood of $15,000 at the start.

Tacoma, Wash.—Donald Fletcher, a Tacoma real estate man, appeared before the Commissioners of King County in an effort to obtain a franchise along the King County public road leading to Green River Hot Springs for electric feed wires transmitting nearly 100,000 horse-power to be generated by a mammoth water power electrical plant which Fletcher and Eastern capitalists propose to build on the Cle Elum River about seven miles above the head of Lake Cle Elum. Fletcher has already made application for franchises for a line in Pierce County extending through Buckley, Sumner, Orting and Puyallup.

Portland, Ore.—The Portland Railway Light & Power Company has put into use for the first time, one section of the new gas plant, on which it has been quietly at work for nearly three months past. The company has installed an almost complete new plant consisting of a recuperative bench of six retorts, capable of generating 100,000 cubic feet of gas every twenty-four hours, and other expensive modern machinery. The new plant has about three times the capacity of the old plant, the combined capacity of the entire plant being now about 150,000 cubic feet. The cost of the work when completed at the gas plant alone will amount to about $20,000.

ELECTRICAL INCORPORATIONS.

Seattle, Wash.—The Electric-Thermo Alarm Company, $250,000; Watson James Hill, Frederick E. Kreatz.

Tillamook, Ore.—The Tillamook Electric Light & Fuel Company, principal office; capital stock, $15,000; Charles I. Clough, A. K. Case and Henry Crenshaw.

Benton, Wash.—The Benton Independent Telephone Company, Prosser; $4800; Clark E. DeBow, James M. Hobland, Frank P. Jackson, Rufus H. Bone, John T. Brownfield, Thomas J. Stockdale, George C. Lincoln and Ira Carter.

TRANSMISSION.

Alamogordo, N. M.—Merrill H. Fisher is preparing to build an electric power house. It will be 120x35 feet and will cost, exclusive of boilers, engines, dynamos and equipment, $5,000.

Gridley, Cal.—A. C. Musselman and D. A. Matheson of Chico have bonded the Richardson Springs property, owned by J. H. Richardson. The installation of a small power plant, to be operated with water from the second falls, is proposed.

San Francisco, Cal.—At the last meeting of insurance men in regard to the Pacific Light & Power Company's plant at Redondo, no definite conclusion was reached, as the fire was not reported until considerable repair work had been done. An adjuster has been sent to investigate as to the exact extent of the loss, and determine how much of it was due to the explosion.

Ogden, Utah.—Plans for the erection of a power plant at Devil's Gate, in Weber Canyon, have been completed and officials of the Utah Light & Railway Company announce that work will be begun in the early spring. The plant will cost $350,000 and will be built by the Utah Light & Railroad Company, which is a part of the Harriman system. Power lines will be run from the plant to Ogden and on to Salt Lake.

San Francisco, Cal.—The Bay Counties Power Company has a gang of linemen at work on the main line in Solano County installing what are termed safety nets at all points where the electric wires pass over the Southern Pacific tracks. These nets are composed of a number of wires strung on separate poles below the live wires and arranged for the purpose of catching the main current wires in case of a break, and thus preventing any serious damage being done to trains or to telegraph lines.

TELEPHONE AND TELEGRAPH.

Winnemucca, Nev.—The Utah-Nevada-Idaho Telephone & Telegraph Company has closed a deal for the purchase of the Home Telephone Company having lines in Winnemucca and to Goldbanks, Paradise and Golconda. By this purchase the Utah-Nevada-Idaho Company has secured a telephone service from Salt Lake into all of the important towns of Eastern and Southern Nevada, from Salt Lake to Ely, from Ely to Tonopah, and from Tonopah to Fairview, Wonder and Rawhide. They will now connect the Fairview line with Winnemucca. The company will begin construction of a number of lines which will eventually connect Winnemucca with San Francisco.

Los Angeles, Cal.—Application has been made to the Council by oil men for a permit to lay about ten miles of pipe along Western Avenue from the north city limits southerly to Vernon Avenue, easterly to the river, and by an almost direct line to the city limits. The purpose of the pipe is to supply tanks miles from the oil fields and to have a quicker way of getting oil to the factories.

Rhyolite, Nev.—J. F. Phelan reports that the Virgin River Oil & Development Company, controlled by Rhyolite parties, has struck a good flow of oil eight feet from the surface.

THE
Journal of Electricity, Power and Gas
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MARCH 21, 1908 No. 12

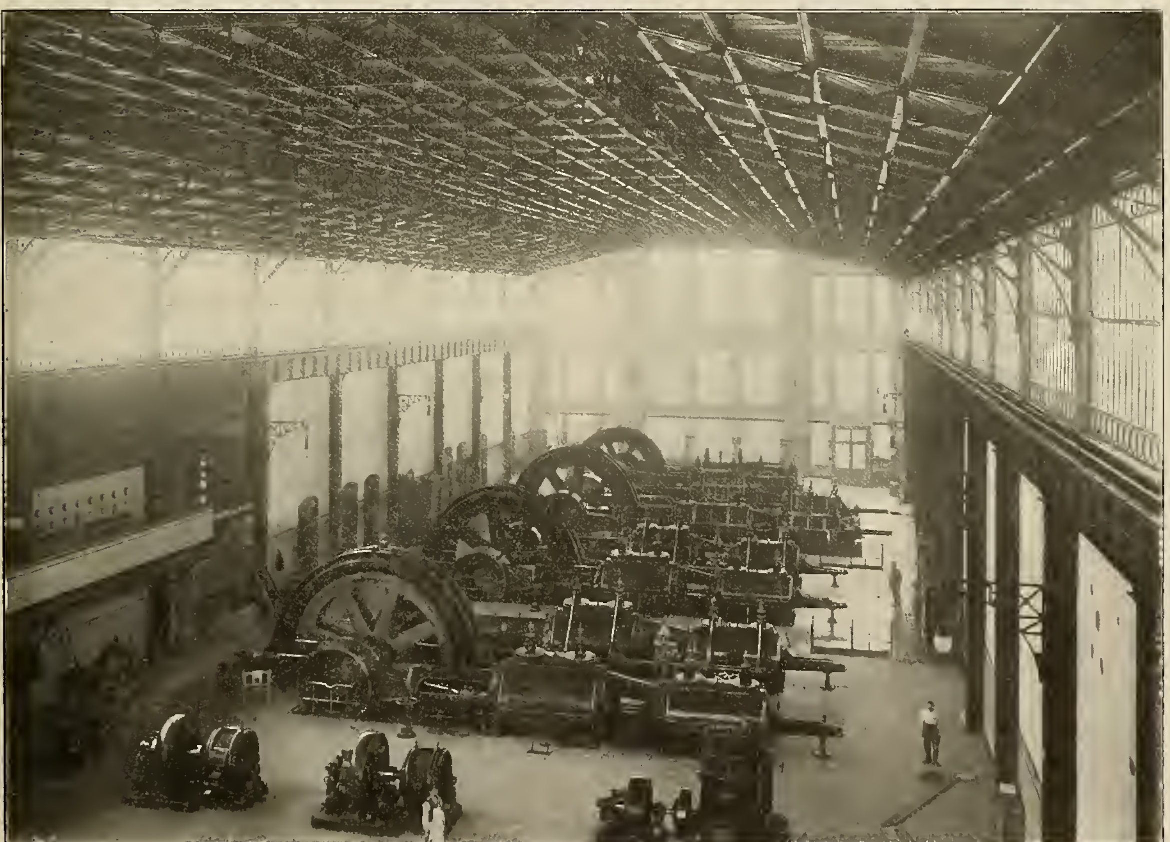
ELECTRICAL GENERATING STASION AT BRUSSELS.

By J. B. VAN BRUSSEL.

An interesting account of the application of American boilers to European needs is contained in this account of the new central station at Brussels.

In 1893 the first electric plant was built in Brussels, with a capacity of 1,000-horsepower, for operating a continuous-current dynamo, supplying current on the three-wire system at 110 volts. There were also two small sub-stations, working in conjunction with the main central station, and these contained gas engines of 120 and 60 horsepower. It soon became apparent that the demand was greater than the supply, and in order to cope with the increased requirement, three new engines of 500-horsepower each were subsequently added, and these also were shortly augmented by three others, each capable of developing 1,000 horsepower. In ten years' time, that is, at the close of 1903, the total power available amounted to 6,500 horsepower, and there was a further accumulator capacity of 19,400 ampere-hours. The rapid increase had surpassed the expectations of the designers of the station, and so about this time the construction of new works was carefully considered, and it was decided to build a new station. The new works, which were commenced in 1904, have just been completed at the Quai des Usines, on the banks of the Willebroeck Canal, near to Schaerbeek-Station.

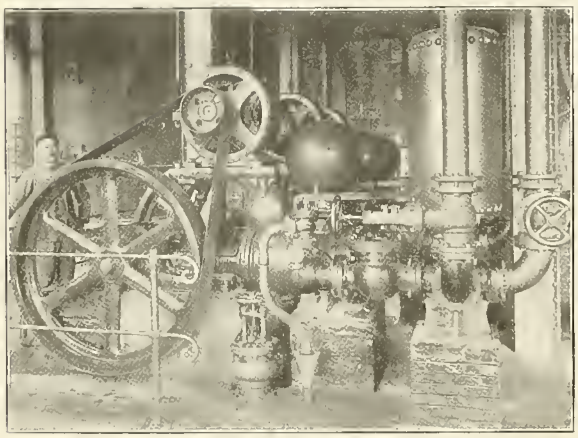
The foundation of the machinery and boiler-houses is of concrete, 75 cm. deep, which rests on a sand bed of 80 cm. thickness. The reinforcement of the concrete consists of transverse and longitudinal steel bars and wire. The main building, containing the machinery and boilers, consists of a steel framework, which rests on masonry. A metal chimney stack is used, and this alone weighs 1,200 tons, and has a height of 195 feet. Two masonry aqueducts have been built for the supply of condensation water. Each of the aqueducts discharges water into a canal through four pipes, each two feet in diameter. A fan fitted to the pipes facilitates the discharge. On the aqueduct leading from the condenser there is an oil separator, consisting of a series of masonry baffles.



ENGINE ROOM OF BRUSSELS GENERATING STATION.

The distance between the collecting and discharging ends of the aqueduct is 100 m.

The boiler-house is 100 feet in length by 55 feet broad, and contains ten Babcock & Wilcox boilers. Each boiler has 3,600 square feet of heating surface, and a grate area of 31 square feet. The plant is divided into five groups of two boilers, and each boiler is fitted with a superheater, which has 545 square feet of heating surface. The normal working pressure of the boilers is 215 pounds per square inch. A Green economizer is used in conjunction with the boiler plant, and is divided into two units, which together have a total heating surface of 19,600 square feet. There is a by-pass between the economizer and the boilers, which allows the gases to be sent direct to the chimney without first passing through the economizer, should this course be desired. Water is supplied to the boilers by electrically-driven "Express" pumps, which have a duty of 66,150 pounds of water per hour, or approximately 6,600 gallons. The motors are mounted above the tops of the pumps, which they drive by means of belts. In a plant of this description it is almost a necessity to have a large pumping plant as a stand-by, and for this purpose two Worthington pumps having a duty of 55,000 pounds an hour are used.



ELECTRICALLY DRIVEN FEED PUMP.

The main feed-pipe, which is made of weldless steel, is duplicated, one of the branches passing through the economizer, the other going direct to the engines. A water-softener plant of 10,000 gallons an hour capacity is used to supply the feed-pumps with purified water for the boilers. The condensed water is pumped into the purifiers by means of two centrifugal pumps, each of which has a capacity of about 6,000 gallons an hour. They are operated by motors of four and one-half horsepower, having a potential difference of 220 volts. The motors are direct-coupled to the pumps, and they are all mounted on a common foundation bed.

The plant erected for handling the coal is designed for dealing with twenty tons per hour. The coal is brought to the works either by boat or railway, and unloading is carried out by means of an electric crane capable of lifting two and one-half tons. The coal is deposited on a Robins belt, on which it is taken to the bunkers. This conveyor passes underneath the quay, and is inclined at a gradient of one in five to the bunkers. From here the coal is carried to the main building by a second belt, and on its way there it is weighed in a Blake-Denison automatic weighing machine. The stokers also weigh the quantity of coal consumed by each boiler, by means of a Schenk weighing machine.

The engine-house is a large, well-lighted building, its principal dimensions being 300 feet in length by 86¼ feet wide. At the present time the plant comprises four combined sets of engines and generators, but there is plenty of room for two auxiliary units when they are required. Three of the units have an output of 3,100 kilowatts each; the fourth is somewhat smaller, being only 1,800 kilowatts. The engines have not all been made by the same firm; those for one of the large alternators, and the small ones, were constructed by the firm of Van den Kerchove, the special feature in these engines being the use of piston valves, which are actuated by a trip gear. The other engines were built by the firm of Carels Brothers, and the valves of these engines are of the Sulzer type. Each unit consists of a horizontal compound steam engine, which drives a three-phase alternator. The engines are condensing, the barometric principle having been adopted, the apparatus used being shown in the engraving.

The following are the principal dimensions of the Van den Kerchove engines:

	First Engine.	Second Engine.
Diameter of high-pressure cylinders.	26 in.	34¼ in.
Diameter of low-pressure cylinders.	45 in.	5 feet.
Ratio $\frac{\text{Area of H.P. cylinder}}{\text{Area of L.P. cylinder}}$	2.99	2.97
Stroke	54	5 feet.
No. of revolutions per minute	94 in.	83
Piston speed	14 ft. per sec.	13.8 ft. per sec.
Working pressure . .	140 lbs. per sq. in.	140 lbs. per sq. in.
Normal admission . .	0.32	0.32
Horsepower	2,600	4,500

The Carels' engines are also condensing. The valves are of the double-seated equilibrium type, and they are actuated in the usual manner by means of four eccentrics on the crank shaft, two for operating the admission valves, and two for the exhaust valves. The releasing gear is worked from the same rods as the valves, in order to reduce the inertia of their motion. This mechanism is a special device introduced by Carels-Sulzer to prevent any damage being caused owing to shock, and at the same time it is claimed to give swiftness in running. The principal dimensions of the Carel engine are:

Diameter of high-pressure cylinder	33½ in
Diameter of low-pressure cylinder	55 in.
Ratio of $\frac{\text{Area of low-pressure cylinder}}{\text{Area of high-pressure cylinder}}$	2.71
Stroke	53.14 in.
Number of revolutions per minute	83
Piston Speed	12.5 ft. per second
Working pressure	240 lbs. per sq. in.
Cut-off high-pressure cylinder	0.435
Horsepower	4,500

There are three condensers, and the exhaust steam from each engine enters a common pipe in which the vacuum is maintained by one of the three condensers already referred to. The condensation water is taken from the feed-water

aqueduct, and pumped up to the top of the barometric condensers by means of electrically-driven pumps which are of approximately 150 horsepower. Each unit produces a vacumm of 92 per cent, at normal working, which is 1,250,000 pounds of steam an hour, and of 88 per cent, at an output of 1,500,000 pounds of steam per hour, the water being at 10 degrees Centigrade when it is taken out of the canal.

The three large 3,100 kilowatt-ampere alternators generate tri-phase current of 5,000 volts at 83 revolutions per minute. Each alternator has 72 poles and a frequency of 50 per second. The armature is 19 feet inside and 21.75 feet outside diameter, its weight is about 33½ tons, and the total weight of the field magnets is 75 tons. The following figures were guaranteed by the makers when the machines were ordered:

Load.	5 4.	1	½
Efficiency	97 pr cent.	97 per cent.	95 per cent.
Excitation in kw....	40	37.2	32

CONDENSING PLANT.

The makers further maintained that the alternators would sustain an overload of 15 per cent for two hours, and of 40 per cent for three minutes. The variation of the pressure between full load and when running light lies between 7 and 8 per cent. The rise in temperature of the windings of the armature and field magnets after eight hours' running at full load does not exceed 45 degrees Centigrade, and after two hours' running, at 15 per cent overload the temperature does not exceed 55 to 60 degrees Centigrade. The high-tension windings were tested with a voltage of 10,000 for half an hour, and the excitation windings with a pressure of 500 volts.

The smaller alternator, which is an 1,800-volt-ampere machine, is of the same type as the others. Its normal speed of running is 94 revolutions per minute, and it has 64 poles. A somewhat similar guarantee was given with this machine to that just quoted. At a quarter overload the efficiency is 96.5 per cent., and it is the same for full load, whilst at half load it drops to 94.5 per cent.

Two groups of rotary converters driven by steam engines, supply the necessary continuous current for the excitation of the tri-phase alternators, as well as the current for working the motor-driven pumps, and also for charging the battery of accumulators. The transformer sets consist of a synchronized tri-phase motor coupled direct to a continuous-current dynamo. The motor develops 275 horsepower at 5,000 volts at its normal speed of running, 250 revolutions per minute. The dynamo is a 200-kilowatt machine, and generates current at 250 volts.

A small steam-driven plant for excitation purposes is illustrated in Fig. 3. The steam engine is one of Carels' high-speed type, and is fitted with rotary valves. At 220 revolutions per minute the dynamo develops 95 kilowatts at 220 volts. In the guarantee which the makers gave it was stated that the efficiency at one-quarter overload would be 94 per cent, and the same for full load. At half load the efficiency would be 90 per cent. There is a battery of accumulators automatically controlled for charging and discharging, which is used for supplying current for lighting, and at the same time to act as a regulator. This battery consists of 130 Tudor cells, having a capacity of 540 ampere-hours for discharge of three hours. The current for the lighting and power used in works is obtained from the bus-bars of the batteries and exciters.

Considerable care was exercised in the design and construction of the switchboard and its auxiliary gear in order to make everything as automatic as possible, and to ensure safety with the use of high voltages. The switchboard is placed on a platform about 13½ feet above the floor level. The high-tension wires are connected behind the board, and are there protected by wire netting. The different high-tension systems are protected the one from the other by masonry partitions. All the high-tension switches have oil breaks operated from some distance away by mechanical means, so that they need not be touched by hand. The measuring instruments are worked with transformers, which are earthed so that it is impossible to get a shock if they are touched.

The switchboard can be subdivided, so that, if necessary, alterations and repairs can be performed without stopping the plant. A synchronism indicator and control volt-meters are placed in prominent positions on the board. There are no fuses in the high-tension circuits, these being protected by a maximum cut-out device of maximum with delayed action. The high-tension feeders are further protected by Warth lightning arresters branched triangularly between the phases which come into operation in case of accidental rises in voltage. A static earth indicator, made by the General Electric Company, is the only high-tension measuring instrument on the switchboard, and this is placed quite out of reach of any of the operators.

The current from the central station is transmitted to five sub-stations, each of which can be isolated from the others. These sub-stations, called as A, B, C, D, and E, do not differ one from the other, except in the number and size of the units they contain. The sub-station A contains four groups of rotary converters of 700 kilowatts, and one battery of 7,800 ampere-hours capacity. The sub-station B has six groups of rotaries, each of 375 kilowatts capacity, and a battery of 3,000 ampere-hours capacity. The sub-stations C, D, and E, each comprise two groups of 200-kilowatt rotaries, and batteries of accumulators with a capacity of 3,000, 2,000, 3,600 ampere-hours, respectively. The rotary converters consist of synchronous motors receiving current at 5,000 volts, direct-coupled to continuous-current dynamos generating current at 250 volts. As the delivery of the current is on the three-wire system, balancers have been provided.

GENERAL THEORY OF COMMUTATION AND OF THE REPULSION MOTOR.*

By E. F. Alexanderson.

The pure repulsion motor has a rotating field, and it appears plausible that commutation may be good in a rotating field, provided that the armature rotates at approximately the same speed as the field. However, a rotating field is not in itself a guarantee of good commutation.

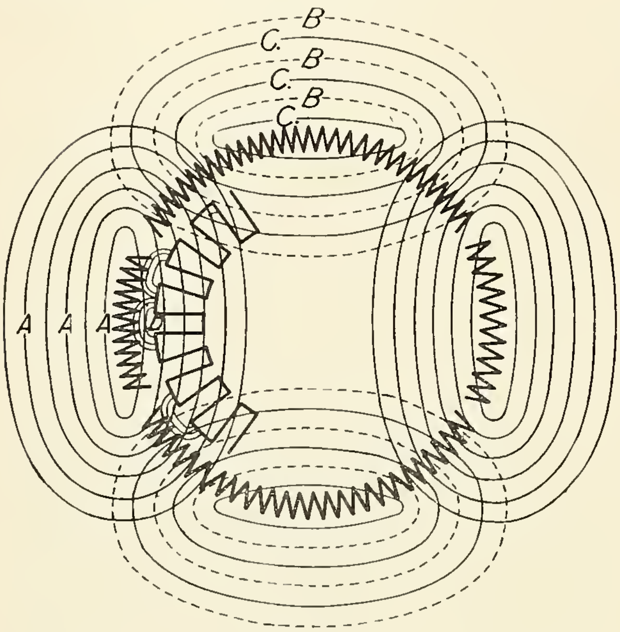


Fig. 2

When the field becomes ellipitical in shape, it is difficult to grasp the phenomena of commutation unless the field is resolved into its components and expressed as functions of time and space. If this is done, the following field components influence the commutation, as illustrated in Fig. 2.

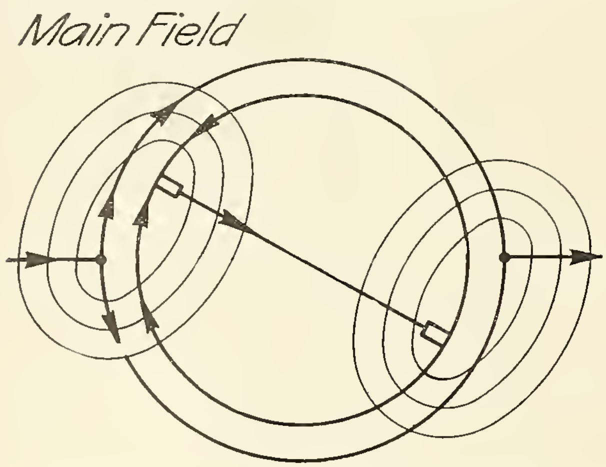


FIG. 3.

A. The "main field," which is the torque-producing field, and corresponds to the field in a series motor.

*Abstract of paper presented before the American Institute of Electrical Engineers, New York, January 10, 1908.

B. The cross-field magnetized by an exciting current flowing in the armature, and serving to transfer the energy from rotor to stator. This field is in quadrature with the main field in time as well as space.

C. Another cross-field magnetized by the difference between the ampere-turns of the armature and the inducing winding. This field is in phase with the main field.

D. The leakage flux around the commutated coils.

The conditions for perfect commutation are as follows:

1. The electromotive force of alternation of the main field should be neutralized by the electromotive force of rotation in the cross-field designated "B."

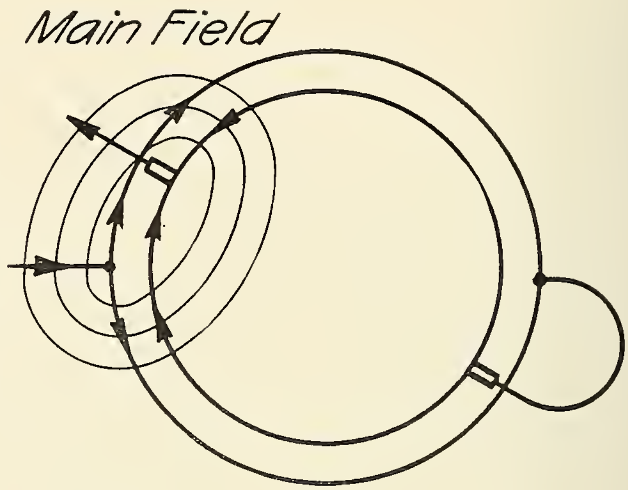


FIG. 4.

2. The magnetomotive force of the stator should be larger than the armature reaction; the difference, which is the field designated "C," should be large enough to overcome the voltage due to the leakage flux.

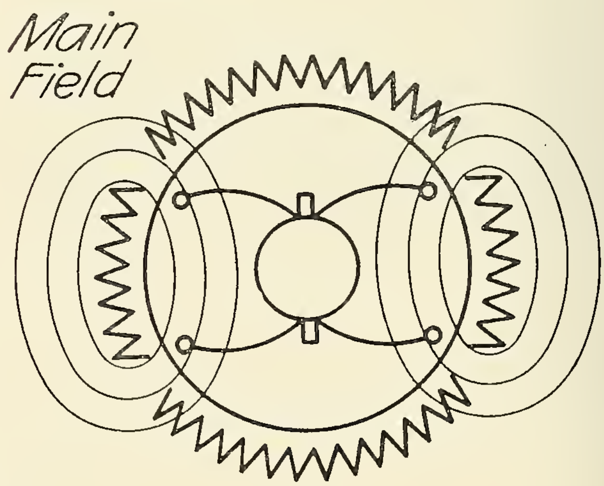


FIG. 5.

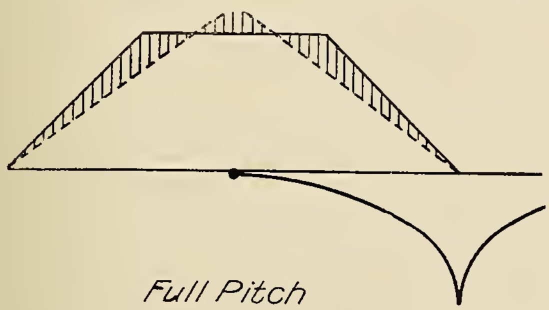
If these conditions are fulfilled the commutation is identical with that of a direct-current motor with commutating poles.

The first condition is found at synchronous speed in a repulsion motor, and theoretically in a series motor at infinite speed. In a series repulsion motor it can be obtained at any speed by varying the proportion between series and repulsion motor action.

This, however, meets only one of the fundamental conditions necessary for good commutation; there are others which will affect commutation as much as will shifting the brushes of a direct-current motor from the right to the wrong side of the neutral.

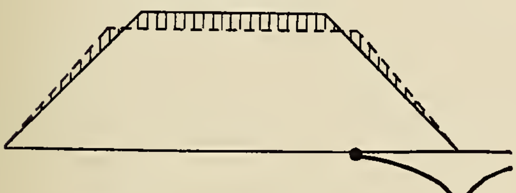
The type of motor which is generally referred to as a repulsion motor is that with a continuous stator and rotor winding, and the brushes shifted in the direction of rotation as in Fig. 3.

If such a motor is used as a series motor with a stator and rotor connected in series, it is apparent from the diagram shown in Fig. 4 that that part of the windings which is included in the angle represented by the shift of the brushes constitutes the exciting coils, and the lines of force are distributed as shown on the diagram. The brushes are shifted in the direction of rotation and are located on the edge of the active field. It is well known in direct-current practice that



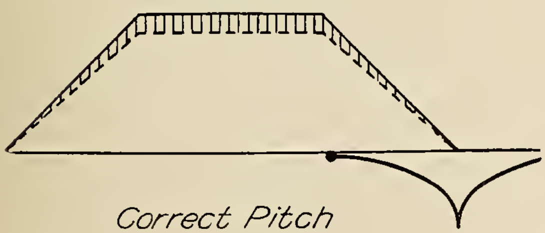
Full Pitch

Fig. 6a



Too Short Pitch

Fig. 6c



Correct Pitch

Fig. 6b

the brushes of a motor ought to have a backward shift, if any, but never a forward shift; and it is therefore obvious, considering the direct-current features, that this motor cannot commutate well. In the repulsion motor, the armature currents are induced by the transformer action, but the distribution of the currents is substantially the same as described above for the series motor. This difficulty has led to the design of an armature winding as shown on Fig. 5, by which the electromotive force due to the cutting of the active flux is eliminated. The magnetization is produced by a separate stator winding located symmetrically with respect to the brushes. This gives a distribution of the fields as shown in Fig. 5. The armature conductors under commutation are located on the edge of the field flux, so that both sides of the coil are under an equal flux of the same polarity.

There is another way of looking at this phenomenon which leads to the same result: the winding of the repulsion motor can be separated into an exciting winding and an inducing winding; in this case the brushes are located in the neutral of the stator winding. The armature is the short-circuited secondary of the inducing winding and must consequently have substantially the same total number of ampere-turns. The two fields that are excited by the stator and rotor individually are shown in Fig. 6 (a). The rotor field is peaked and stator field is flat-topped, giving a resulting field as shown by the cross-section part of the diagram. Consequently, there is a resulting peaked field opposite to the brushes where the conductors under commutation are located. This field is excited by the armature and has all the detrimental effects of armature reaction. Fig. 6 (b) shows how this is overcome by a fractional pitch winding on the armature. It also shows why only one definite winding pitch gives the correct result, whereas a greater or less ratio gives a field in the wrong direction.

The correct combination in Fig. 6 (b) shows the rotor flux slightly lower than the stator flux, whereas if there were no leakage the currents and corresponding fluxes would be equal; but actually, the primary is a little higher, due to the leakage. The difference between these two fluxes acts as a commutating field; but, on the other hand, the higher the leakage, the higher will be the commutating flux needed to overcome the leakage. If, however, the armature is short-circuited through a reactive coil, the resulting flux is increased without introducing leakage in the armature. Since the field of the motor is a reactive coil itself that must be excited, a convenient way of introducing reactance into the motor armature is to use the motor field or a part thereof for this purpose. That it is beneficial for the commutation of a repulsion motor to introduce the field in the armature instead of the stator circuit, was experimentally demonstrated long ago by E. W. Rice, Jr. The reason for the improvement as explained above, is that the reactance of the field changes the ratio between stator and rotor ampere-turns so as substantially to offset the wrong distribution of currents with the full-pitched winding. The fact of the reactive coil being the field winding is in this respect immaterial, and it has been proved that the field of a similar machine introduced in the same place, gives the same result.

The Anglo-Japanese Oi-gawa Hydro-Electric Power Co. will supply electricity to Shizuoka and other cities on the Tokaido by utilizing the cataracts of the great Oi River. About 66,000 horsepower are available at Tamochimura; about 27,000 more between Ikama-mura and Hambaraumechi, and about 8,000 horsepower at Uchinakubi, in Yamanashi prefecture. The first, being the largest among the three works, will have to be postponed for some time. The second and third will be started in 1908 at an estimated cost of $5,000,000. The company is backed by a capital of $5,250,000, half of which will be equally subscribed by the British and Japanese promoters.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

ATTACHMENT PLUG, FUSELESS.

"Benjamin" 3A., 250V., Cat. No. 903, with rotating shell screw and outlet bushing or cap, holding cord without use of knot. Approved Feb. 10, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

WEATHERPROOF PLUGS.

Cat. Nos. 5520 and 5522, 3A., 250V. Approved Feb. 17, 1908. Manufactured by

Harvey Hubbell, 35 Organ St., Philadelphia, Pa.

CURRENT TAP.

Cat. No. 95½, 3A., 250V., series circuit current tap, for incandescent lamp in series circuit tapped from the device through special side outlet provided for this purpose. Approved Feb. 12, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

GROUND CLAMPS.

"D. & D." Ground Connection Clamp. A copper band looped through a ring in special bolt and secured by nut on this bolt. Approved Feb. 11, 1908. Manufactured by

Bernard J. Dever, 1931 Wolf St., Philadelphia, Pa.

LAMP ADAPTERS.

"Hubbell" adapter for Edison base lamp in T. H. sockets and receptacles. Cat. No. 5472, 3A., 200V. Approved Feb. 10, 1908. Manufactured by

Harvey Hubbell, Inc., 37 Organ St., Bridgeport, Conn.

LAMP CLUSTERS.

"Benjamin" Wireless Clusters, porcelain bases and removable porcelain rings. Multiple types, Nos. 1, 2, 3, 3K, 7 with 250-volt snap switch, 8 and K. Series types 1½ and 2½, marked "series connected." Series or multiple type 600 without removable rings. Approved Feb. 17, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

RECEPTACLES, STANDARD.

"Russell" two-piece porcelain receptacle. Cat. No. 276. Approved Feb. 7, 1908. Manufactured by

Freeman Electric Co., Trenton, N. J.

Bryant Receptacles, 3A., 250V. Sign, Cleat, Concealed, Moulding, Conduit Box and Rosette Receptacles. Approved Feb. 10, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

Weber Wall Sockets. Cat. Nos. 61672 to 61677, inclusive. Cleat, Concealed and Angle Base, types 3A., 250V. Approved Feb. 8, 1908. Manufactured by

Weber Electric Co., Schenectady, N. Y.

SIGNS, ELECTRIC.

N. B. Universal Monogram Signs. Metal frames, carrying, by means of slate strips, two plates in which are mounted lamp holders. Chargeable face plates. Approved Feb. 12, 1908. Manufactured by

Electric Carriage Call Co., Christopher St., near Washington St., New York City.

SOCKETS, STANDARD.

Weber brass shell key and keyless. Cat. 61,372 to 61,375, inclusive, 61,573 and 61,575. Approved Feb. 8, 1908. Manufactured by

Weber Electric Co., Schenectady, N. Y.

SWITCHES, PENDANT SNAP.

"Perkins" two-button type, single-pole, 6A., 125V., 3A., 250V. Cat. Nos. 2,353, 2,354, for either pendants or fixtures, and 2359 for fixtures only. Approved Feb. 17, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

WIRE, SLOW-BURNING.

Insulation consisting of three braids. See Rule 43, Nat'l Elec. Code (1907 edition). Approved Feb. 17, 1908. Manufactured by

Collyer Insulated Wire Co., Pawtucket, R. I.

CABINETS.

"Wurdack" built up and formed steel cabinets, with or without slate or asbestos gutters. Steel or wood fronts, with or without glass panel in door. Approved January 18, 1908. Manufactured by

Wurdack Elec. Mfg. Co., 19 S. Eleventh St., St. Louis, Mo.

CONDUIT OUTLET PLATE.

"Fancleve." Cat. Nos. 601-605, inclusive, for knob and tube work. Cat. No. 700, for flexible armored cable. Approved January 15, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

LAMP CLUSTERS.

"Benjamin" newer multiple types, Nos. 5 and 5K, having metal ceiling plates, porcelain bodies and outer shells, without removable rings. Approved January 18, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

RHEOSTATS.

Drum controllers of types, voltages and horsepower as described in manufacturer's bulletin Nos. 66, 66A, 67, 67½, 68, 68½, 69, 72B, 77 and 78. Approved January 18, 1908, when properly installed in connection with suitable resistance elements. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Form P. and P. M. resistance units. Sizes A, B and C. Asbestos tubes wound with resistance coil and covered with cement. Approved January 17, 1908, when suitably mounted on bases of non-combustible material. Manufactured by

General Electric Co., Schenectady, N. Y.

G. E. motor starting. Types S A and S B, with field control. Type S F A; also type R A, speed regulating rheostat for continuous duty; 125-500-volt. Approved January 18, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

SOCKETS, STANDARD.

Right angle and twin sockets, with swivelling, screw plug attachment. The twin sockets are arranged for two lamps in series. Cat. Nos. 941 and 942½. Approved January 18, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

CONDUIT OUTLET PLATES.

"Fancleve." Cat. No. 601-605, inclusive, for knob and tube work. Cat. No. 700, for flexible armored cable. Cat. Nos. 171 to 175, inclusive, for use with canopies of fixtures where supply wires are in wooden moulding. Approved Feb. 29, 1908. Manufactured by

John S. Gleason, 290 South St., Jamaica Plain, Mass.

CURRENT TAP.

Cat. No. 95½, 3A., 250V., series current tap, for incandescent lamp in series circuit tapped from the device through special side outlet provided for this purpose. Approved Feb. 13, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Blvd., Chicago, Ill.

CUT-OUT BASES, CARTRIDGE FUSE.

Cut-out Bases, Cartridge Fuses, 250 and 600 volts, all capacities. Fuse terminals of standard dimension and spacing, mounted on slate bases. Also similar patterns on slate bases with slate barriers between parts of opposite polarity. Approved Feb. 25, 1908. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

LIGHTNING ARRESTERS.

"Shaw Non-Arcing," for A.C. and D.C. circuits. Approved March 2, 1908. Manufactured by

Lord Electric Co., Fuller Bldg., New York, N. Y.

RHEOSTATS.

Multiple switch, motor-starting rheostats, described in Bulletin 10½. Approved Feb. 26, 1908, either when equipped with a push-button device or when equipped with "hand-over-hand" operation, with holding magnet on last lever, making it impossible to leave the starter with only a portion of the switches closed. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

SIGN MACHINE.

"Skeedoodle J," 10, 15, 20 and 25 amperes, 125V., single or double pole. A thermostatic flasher consisting of carbon contactors carried on steel springs and mounted in cast-iron box, having pipe extension containing the thermal element. Approved Feb. 29, 1908. Manufactured by

Electric Ad. Company, 64 State St., Detroit, Mich.

SOCKET, WEATHERPROOF.

Freeman Weatherproof Socket and Vaporproof Globe, styles A, B and C, 3A., 250V. Approved March 2, 1908. Manufactured by

E. H. Freeman Electric Co., Trenton, N. J.

SWITCH BOXES.

"Fancleve" cast-iron conduit switch and outlet boxes. Cat. Nos. 501 and 351. Approved Feb. 28, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

WIRE, SLOW-BURNING.

Insulation consisting of three braids. Approved March 2, 1908. Manufactured by

Benedict & Burnham Mfg. Co., Waterbury, Conn.

BUSHINGS.

"P. & S." All porcelain bushings for use on wood or steel cut-out cabinets. Supported by means of screw or stove bolts. Cat. Nos. 55, 56, and 57. Approved Feb. 24, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

CIRCUIT BREAKERS

Type K, Forms L, M, N, O, P, Q. All capacities, 250 and 600V. Approved Feb. 24, 1908. Manufactured by

Conduit Electrical Mfg. Co., Boston, Mass.

LAMP CLUSTERS.

"Dale" Wireless Clusters, types Nos. 197 and 130. Multiple only, type No. 227. Also above types with fixture stem, reflectors and shades. Approved Feb. 10, 1908. Manufactured by

The Dale Company, 9th Ave. and 13th and Hudson St., New York, N. Y.

PANELBOARDS.

125 and 250V., 2 and 3-wire boards equipped with knife switches and terminals for cartridge enclosed fuses. Approved Feb. 15, 1908. Manufactured by

Electric Mfg. Co., 926 Lafayette St., New Orleans, La.

RHEOSTATS.

C. H. Universal Motor Starters, described in Bulletin 21. Having overload motor starter and knife switch and terminals for N. E. cartridge enclosed fuses mounted on a slate base. Approved Feb. 21, 1908. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

FLOW OF WATER IN OPEN CONDUITS.

A. P. Merrill gives the following formula for calculating the flow of water in open conduits, in a recent number of "The Engineering Record":

$$V = C\,S^a\,R^b,$$

in which

V=velocity of flow in feet per second.

S=slope, or the sine of the angle of inclination of the conduit.

R=hydraulic radius, or the cross-sectional area of the stream divided by the length of the wetted perimeter.

The following is a summary of the numerical results:

Ordinary Conduits: $a = 0.43$; $b = 0.869/V^{0.25}$

	C
For unplaned plank	=78
For lath in flume .12′ c. to c	=64
For lath in flume .25′ c. to c	=44
For pure cement	=94
For small gravel	=56
For large gravel	=45
For brick (not very smooth)	=75
For smooth masonry	=77
For ordinary channels in earth	=22—32

Semicircular Conduits: $a = 0.46$; $b = 6.929/V^{0.25}$.

	C
For partly planed plank	=97
For pure cement	=114
For cement with one-third sand	=104
For small gravel	=74

Rivers and Large Canals: $a = 0.76$; $b = 1.552/V^{0.25}$; $C = 174$ to 248.

It is seen that C in the above summary varies through a wide range for rivers and large canals. The investigation on these large streams was not sufficiently extensive to warrant giving a more definite co-efficient.

After the final exponential equation was determined, and the values for the co-efficient obtained, the writer computed, by the formula submitted, the values for the velocities, using each of the readings given in 43 of the tables used. With one exception, the average computed velocity for each table differed from the average measured velocity by less than six per cent, while in the majority of cases, the difference was under two per cent.

Wood poles to the number of 3,574,666 and worth $9,471,171 at the place of purchase, were used by telegraph, telephone and electric light and power companies during 1906, according to Forest Service Circular 137. Of these 60 per cent were cedar; 25 per cent chestnut; 5 per cent pine; 3 per cent cypress; 1½ per cent juniper; ¾ per cent redwood, and the rest oak, fir, and miscellaneous. The average price was $2.65 apiece, round poles selling for $2.63, and sawed for $4.22 each, there being only 47,791 of the latter. The telegraph and telephone companies purchased about two-thirds of the total, and the street railway, light and power companies about one-quarter. The Lake States furnished about half the total, and nearly 80 per cent of the cedar output, Idaho and Maine, with adjoining States, giving the bulk of the remaining cedar production. Chestnut poles come from Pennsylvania, Maryland, Virginia, and West Virginia; cypress poles from the Gulf States; juniper from Virginia, the Carolinas and other South Atlantic States; redwood comes wholly from California, together with pine, supplementing cedar on the Pacific Coast.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MARCH 21, 1908 No. 12

EDITORIAL.

NEW SINGLE-PHASE MOTORS.

In compliance with a reader's request, we publish an account of the general theory of the repulsion motor and of commutation, as written by Mr. E. F. Alexanderson in describing "A Single-phase Railway Motor." As shown in the abstract of the paper presented before the American Institution of Electrical Engineers, printed in our issue of February 8, 1908, the characteristics of the repulsion motor give the desired starting qualities when combined with those of the series-compensated motor to obtain good running. In the new motor a winding produces the repulsion effect and compensates the armature reaction. The conductors are brought under the field poles at the time of commutation by means of a fractional pitch winding.

APPLICATION OF CHEMISTRY TO ELECTRICITY.

The aid given by electricity to chemistry is but little greater than what the chemist has done for the electrical engineer. Each inosculates and depends upon the other and exemplifies the strength given by co-operation. Chemistry forms the basis of all engineering work in this age of iron and copper. Confining our attention to the one branch of electrical engineering, we find chemistry entering into almost every factor from the generation to the utilization of the current. Power houses are often built of concrete, for whose strength and durability the chemist is responsible when he compounds and tests the cement. Dynamos are made largely from iron and copper, whose dependence have already been indicated. They are sometimes driven by steam, whose feed water must be examined and whose fuel as well as flue gases must be chemically analyzed, to gain the greatest efficiency. To the chemist is due the development of new lubricating oils, but as yet he has not found a successful substitute for rubber.

In transmission, the chemist has largely been concerned with the preparation of glass and earthenware insulators that would withstand the necessary stresses. Porcelain for electric purposes forms about 10 per cent of the total value of pottery products in this country. It is made either by a wet or a dry process, high-tension insulators being moulded and lathe-turned from the former, and knobs, cleats, receptacles, plugs, switch-bases, etc., being pressed from the latter. The right proportion of feldspar, clay and quartz determined by the chemist is essential to a uniformly good product.

Of the various high efficiency metallic filament lamps recently put on the market, none could have been developed without the chemist's knowledge of the proportions and method of extraction of these metals. A long series of careful chemical experiments preceded the mechanical manufacturing processes. The work of the chemist is likewise most essential in the development of accumulators, as well as primary batteries.

But even more fundamental has been its function in providing processes such as the cyanide and chlorination, whereby gold is extracted from refractory ores. Again, with regard to the commercial success of any product, a market must either exist, or be created, and while there has been but little trouble in the marketing of electricity, a time may come when the great current consumption of large electro-chemical industries will be welcomed. These are but some of the instances in which chemistry has been used as an aid for electricity and show how important its knowledge is to the engineer desirous of attacking a problem correctly. It makes obvious the contention that the community having the best chemists will most successfully compete with others for the concomitant advantages of commercial supremacy.

These facts and those in a discussion of the application of electricity to chemistry show that no one science can be given precedence over another, but all have advanced together, acting and reacting upon each other, just as they have influenced our art, our reasoning or our language.

THE JOVIATION OF THE REJUVENATED SONS OF JOVE.

At the Hotel Southland, Dallas, Texas, 7 p. m., February 29, 1908.

The Contractor's Soliloquy.

"To cut, or not to cut, that is the question.
Whether 'tis not better in the end
To let the chap who knows not the worth
Have the work at cut-throat price, or,
To take up arms against his competition,
And, by opposing cut for cut, end it.
To cut, and by cutting put the other cutter
Out of business; 'tis a consummation
Devoutly to be wished. To cut, to slash,
Perchance myself to get it in the neck,
Ay, there's the rub; for when one starts
To meet the other fellow's price, 'tis like as not
He's up against it good and hard.
To cut and slash is not to end confusion
And the many evils the trade is pestered with;
Nay, nay, Pauline; 'tis but the forerunner
Of debt and mortgage such course portends.
'Tis well to get the price the work is worth
And not be bullied into doing it
For what So-and-So will do it for.
Price-cutting doth appear unseemly
And fit only for the man who knows not
What his work is worth, and who, ere long,
By every stress of making vain comparison
'Twixt bank account and liabilities,
Will make his exit from the business."

Menu.

Jovian Rotary Converters
Neptune's Generators
Cut-outs Hang-outs Blow-outs
Electrolyte a la Lucifer
Submarine Boosters
Jupiter's Synchronizers
Apollo's Milk Turbines
Juno's Exciter
Insulating Joints au Avrenim
(New Code)
Ground Detectors Corroded Contacts
Rejuvenated Trouble Shooters
Vulcan's Soldering Paste
Polarity Indicator a la Pluto
Voltage Regulator de Hercules
Mars' Fuses
"SHOCKED"

PERSONAL.

J. W. McDowell, of the Manhattan Electrical Supply Co., of New York City, is in San Francisco on one of his annual trips.

Geo. R. Carr, vice-president of the Dearborn Drug & Chemical Works, is on a combination business and pleasure trip to the City of Mexico.

A. Press, formerly connected with Siemens & Halske, has become chief electrical engineer for the American Transformer Co., of Newark, N. J.

John W. Brashears, who for many years has been first assistant to W. A. Converse, chemical director of the Dearborn Drug & Chemical Works, in charge of their analytical laboratories, has been appointed assistant superintendent of the manufacturing department.

TRADE CATALOGUES.

H. Krantz Manufacturing Company, of Brooklyn, N. Y., send copies of their re-issued bulletin on ceiling switches without springs.

The F. Bissell Company, of Toledo, Ohio, send Bulletin No. 19, listing direct-current security switchboards for isolated and central-station plants.

Bulletin No. 4566, just issued by the General Electric Company, Schnectady, N. Y., describes some new types of tantalum lamps, which are now on the market. The lamps are rated for 40, 50, and 80 watts. Under the heading "Solution of Illuminating Problems," an interesting outline is given of the best methods of selecting proper units for various conditions.

The General Electric Tungsten Lamp for street lighting is described in Bulletin No. 4571. Data and prices, candlepower, distribution, curves, and illustrations of the lamp, and ornamental brackets used in street lighting are given. The lamps are rated at an efficiency of 1¼ watts per candlepower, with an estimated life of approximately 1,000 hours. On this basis a comparison of the carbon filament lamp, taking 3.5 watts per candlepower, shows that the G. E. Tungsten Lamp gives a saving of 90 kilowatt-hours per lamp, and at two cents per kilowatt-hour this makes the actual value of the tungsten lamp $1.80 greater than the carbon filament lamp.

One of the most artistic electric fan catalogues of the season is Bulletin No. 4560, just issued by the General-Electric Company. The catalogue is conveniently arranged for reference, two or three fan motors being shown on each page, with a brief description in tabulated form and data as to voltage, catalogue numbers, list prices, etc. Descriptions are included of ceiling fans, exhaust fans, and some miscellaneous small motors for blower, drills, buffing and polishing machines, sewing machines, etc. The general color scheme of the book is cream and brown, light tint blocks being used on all the pages. The frontispiece is an excellent reproduction of the painting, "Fame," by Edith Prellwitz, and the cover is a portrait medallion in bright colors.

NOTICE OF REMOVAL.

On and after March 1st, 1908, Harron, Rickard & McCone will be at 461 Market St., Sheldon Building. Shipping department and warehouses, Seventh and Berry Sts., as heretofore.

TRADE NOTICE.

The Engineering & Maintenance Company have been appointed agents for the Crocker-Wheeler Company, for Nevada and Northern California, with offices at 212 Front St., San Francisco. Mr. R. E. Martinez is president; J. W. White, vice-president, and E. O. Hampton, secretary, of this company, which will also conduct a general engineering business.

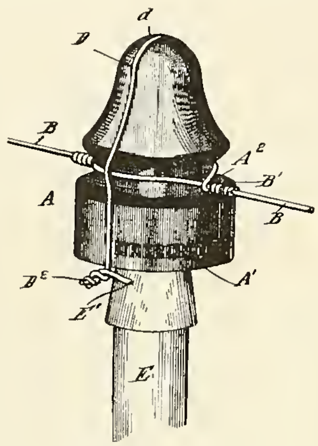
MEETING NOTICE.

The March meeting of the New York Section of the Illuminating Engineering Society was held at the United Engineering Societies Building, 33 West Thirty-ninth Street, on Thursday, March 12th, at 8:15 p. m. The paper of the evening was by Mr. E. L. Elliott, the subject being "The Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint."

PATENTS

INSULATOR. 880,971. George W. Carter, Canyonville, Oregon.

An insulator body having an annular groove for a line wire and its fastening and provided above the said groove with a seat for a tie wire, and a peg receiving the insulator body at its upper end and provided below said body with a trans-



verse opening, and a tie wire passed through said transverse opening and around the insulator body and engaged with the upper seat thereof and having its ends united whereby to retain the insulator body in connection with the peg and the line wire in connection with the insulator body.

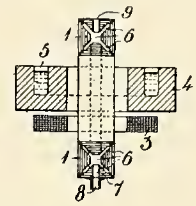
ELECTRODE ELEMENT FOR STORAGE BATTERIES. 880,978. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J.

An electrode element, comprising a perforated inclosing pocket non-deformable under normal working conditions, containing a highly compressed mass of active material, formed

with a net-work of minute circulating passages extending throughout the same and constituting a substantially predetermined porosity, and a net-work of conducting paths formed of overlapping flakes extending throughout the active mass and with which the particles are deformably compressed into intimate contact.

TRANSFORMER FURNACE. 880,547. Axel R. Lindblad and Otto Stalhane, Ludvika, Sweden.

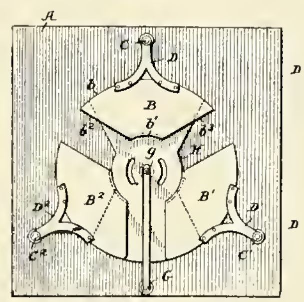
In a transformer furnace, a transformer core formed of an endless member, the member in cross-section being con-



stituted of sector portions meeting at the axis of the member, the sectors being formed of superposed parallel plates or laminae that in each sector are substantially perpendicular to the radius at the middle of the sector, each sector being separated by insulating material.

GROUND-DETECTOR. 880,544. Justus C. Lawler, Colorado Springs, Colo.

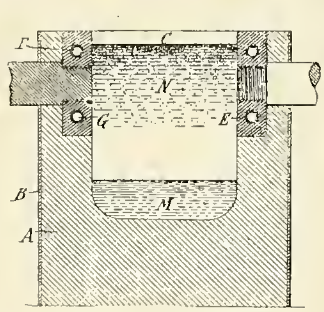
A ground-detector for three-phase electric circuits, com-



prising three plates in a single plane, each plate adapted to be connected to a different leg of the circuit, and a single vane common to the three plates mounted in a plane parallel to the plane of the plates and free to rotate.

ELECTRIC-FURNACE PROCESS. 880,743. Franz von Kugelgen and George O. Seward, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y.

The method which consists in treating in an electric furnace a pyroconductive charge by passing through it from a



carbon electrode in contact with it a current sufficient to maintain the charge molten, and cooling said electrode sufficiently to cause a portion of the charge to be chilled in a protective but conducting coating thereon, whereby such chilled portion forms in effect a new working electrode.

INDUSTRIAL

THE TOMLINSON AUTOMATIC RADIAL CAR COUPLER.

When train operation of electric cars first came into general use, the necessity became apparent for an automatic coupler to fulfill the new conditions, which were different from those in steam road practice. This need was first felt on elevated electric railways, but of late years, with the

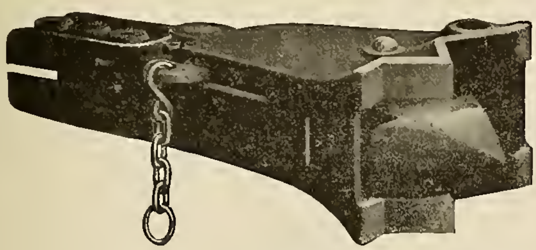


FIG. 1. TYPE A, FORM 1 NO 2 COUPLER FOR RECTANGULAR BAR DRAFT GEAR.

extensive growth of interurban systems, train operation has become more common on surface lines, and the field of the automatic coupler is very much enlarged.

Among the various so-called automatic couplers of the radial type which have come into use in electric railway service, none has hitherto fulfilled the automatic function entirely, inasmuch as previous adjustment or rearrangement

FIG. 2. TYPE A, FORM 1, NO. 2, RECTANGULAR BAR DRAFT GEAR.

of the coupler parts is necessary in order to put the coupler in operative condition. The new Tomlinson automatic radial car coupler, manufactured by the Ohio Brass Company, is, however, a departure from previous practice in this respect, for it is absolutely automatic in action, and no previous adjustment of the parts is necessary to the operation of the coupler. There are no loose links or pins of any description.

The Tomlinson coupler is of the radial type. All that is necessary to couple two cars is to align the couplers and bring the cars together with very little force. Any Tomlinson coupler will intercouple not only with another of its own type and size, but will also intercouple with all other standard radial couplers. By the addition of a simple emergency knuckle it will intercouple automatically with M. C. B. couplers. A combination link can also be furnished, which permits of intercoupling with Van Dorn couplers. These features, therefore, make the Tomlinson coupler a universal device applicable to the cars of any system regardless of the form of coupler already in use.

FIG. 3. TYPE A, FORM 2, NO. 3 CHANNEL BAR DRAFT GEAR. MADE ALSO IN THE NO. 2 SIZE.

The Tomlinson couplers are also made in sizes applicable to any class of service, from the lightest to the

FIG. 4. TYPE A, FORM 2, NO. 3 COUPLER FOR CHANNEL BAR DRAFT GEAR. MADE ALSO IN THE NO. 2 SIZE.

heaviest, and for application to any standard form of draft gear. In short, they are thoroughly practical in every respect, as has been abundantly proven by their satisfactory operation on many of the most prominent electric roads in the country. Following is a detailed description of the coupler, which will be made clear by the illustrations herewith, showing the various forms of the coupler and methods of application:

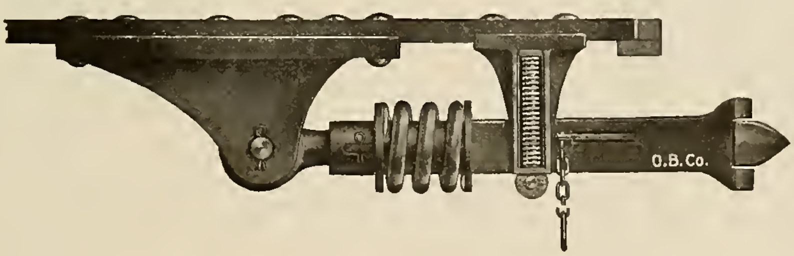


FIG. 5. TYPE A, FORM 4, NO. 3 COUPLER WITH DROP DRAFT GEAR AND SPRING HANGER. MADE ALSO IN THE NO. 2. SIZE.

The coupler, as shown clearly in Figs. 1 and 4, consists

essentially of a strong malleable iron head-piece which is hollow and contains an arrow-pointed, drop-forged coupler hook. This hook is pivoted at the end within the coupler, the arrow point being free to move horizontally. Its play in a horizontal direction is sufficient to allow the hooks of two opposing couplers to slide past each other and become locked. Horizontal movement of the hook beyond the center of the coupler is prevented, but the hook is free to

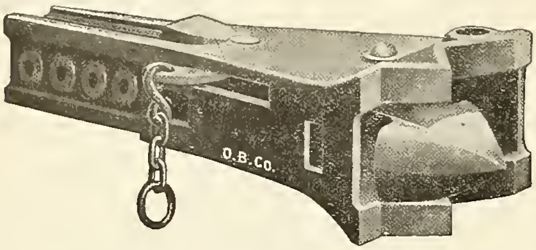


FIG. 6. TYPE A, FORM 3, NO. 2 COUPLER FOR RAIL SECTION DRAFT GEAR.

move toward the side of the coupler in opposition to the action of a spring. The arrangement is such, however, that should the spring in one of the couplers break, and allow the hook to move toward the side, there would not be sufficient clearance to permit the hooks to slide by each other

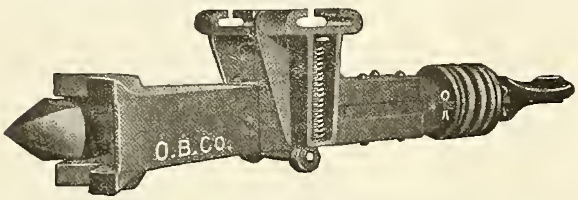


FIG. 7. DRAFT GEAR AND SPRING HANGER AS APPLIED TO TYPE A, FORM 2, NOS. 2 AND 3 COUPLERS.

and uncouple. The springs are under tension only at the instant of coupling or uncoupling, and get no stress of the train load, either pushing or pulling.

In uncoupling, the hooks are forced apart by a lever cam. The cam is actuated by a chain, a slight pull on the chain of either coupler being sufficient to disengage the

FIG. 7½. TOMLINSON-VAN DORN COMBINATION LINK.

hooks. After the couplers have separated, the parts return to their normal position automatically.

An important feature of the coupler, and one which effectually prevents lateral movement of the coupler heads is the serrated or saw-tooth form of the coupler face. The serrations on the faces of opposing couplers fit into one another, and when the couplers are locked, a practically rigid connection is made. Surging between cars, which results with couplers allowing lateral play, is, therefore, prevented, greatly facilitating the control of the train.

To meet service requirements the couplers are made in four forms for attachment to four standard types of draft gears, namely, rectangular bar draft gears, channel bar draft gears, 80-pound rail-section draft gears and drop draft gears. These four forms are shown in Figs. 1. 4. 5 and 6. Figs. 2 and 3 show respectively the rectangular bar and channel bar draft gears.

Beside variation in draft gear connections, the couplers are built in two sizes known respectively as size No. 2 and

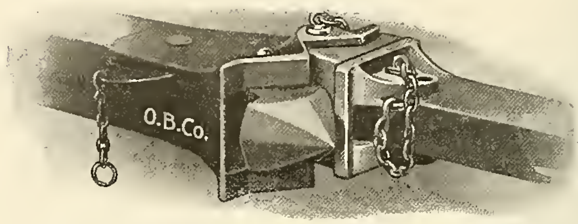


FIG. 8. TOMLINSON AND VAN DORN COUPLED TOGETHER.

size No. 3. The No. 2 couplers are designed to meet the requirements of all classes of city and light interurban service. The No. 3 couplers are adapted to elevated and subway service, also heavy interurban service, and to all service where it is desired to intercouple with steam road cars.

FIG. 9. M. C. B. EMERGENCY KNUCKLE.

Where unduly sharp variations in the grade line make necessary some allowance for vertical play of the coupler and draft gear, the spring hanger attachment, shown in Figs. 5 and 7, is used. The hanger consists of a rectangular casting through which the draft gear passes, being supported by

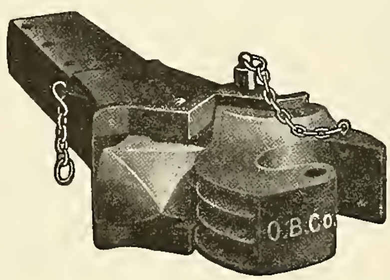


FIG. 10. TOMLINSON COUPLER WITH M. C. B. KNUCKLE.

a yoke which rests on springs, allowing vertical movement either up or down. These springs carry the weight of the coupler and draft gear, and normally hold the former in a position parallel to the car sills. The springs, however, allow vertical movement through a considerable range, so that the coupled cars can conform to any sudden breaks of grade, as caused by viaducts, subways, etc. (see Fig. 11). The hanger is supported by a radial slide bar under the car sills.

The M. C. B. knuckle (Figs. 9 and 10) is a device which makes possible the use of the Tomlinson coupler wherever it is necessary to intercouple with steam road cars. This knuckle is made with a wedge-shaped extension of the right

dimensions to fit into the space in the Tomlinson coupler which ordinarily receives the coupler hook of the opposing coupler. The knuckle is held in place by a pin which passes down through the Tomlinson coupler and the wedge-shaped extension of the knuckle. It is not necessary to remove or derange any of the parts of the Tomlinson coupler to put the knuckle in place, and when once inserted it will couple automatically with standard M. C. B. couplers.

The combination link for intercoupling with Van Dorn couplers (Figs. 7½ and 8), is applied similarly to the M. C. B. knuckle, and is provided with a tongue similar to that on the Van Dorn coupler.

Tomlinson couplers may be applied to any car regardless of its dimensions, distance from grade line to sills, etc., and as indicated by the diagrams, Figs. 12 and 13, the system is exceedingly flexible and can be made to conform to any operating conditions. This coupler is manufactured by the Ohio Brass Co., of ~~Bridgeport, Conn.~~ Mansfield, Ohio, represented by Pierson, Roeding & Company, of San Francisco.

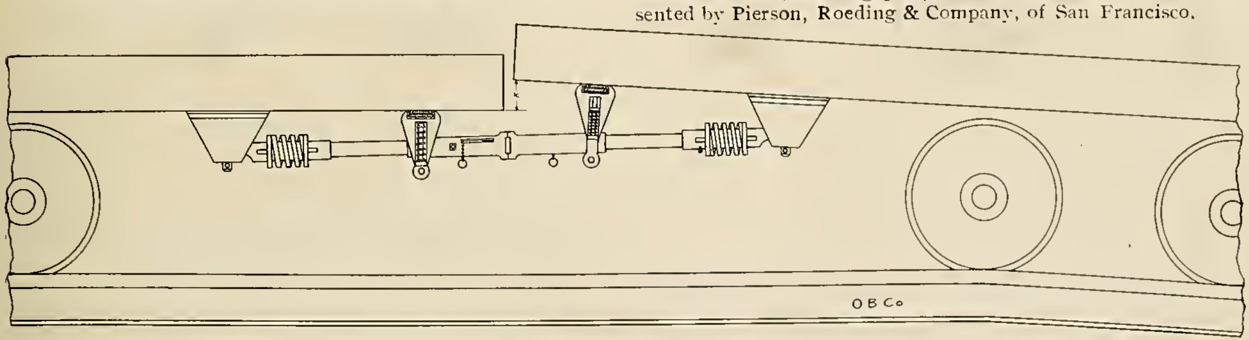


FIG. 11. SPRING HANGERS ADAPTING COUPLERS TO BREAK IN GRADE.

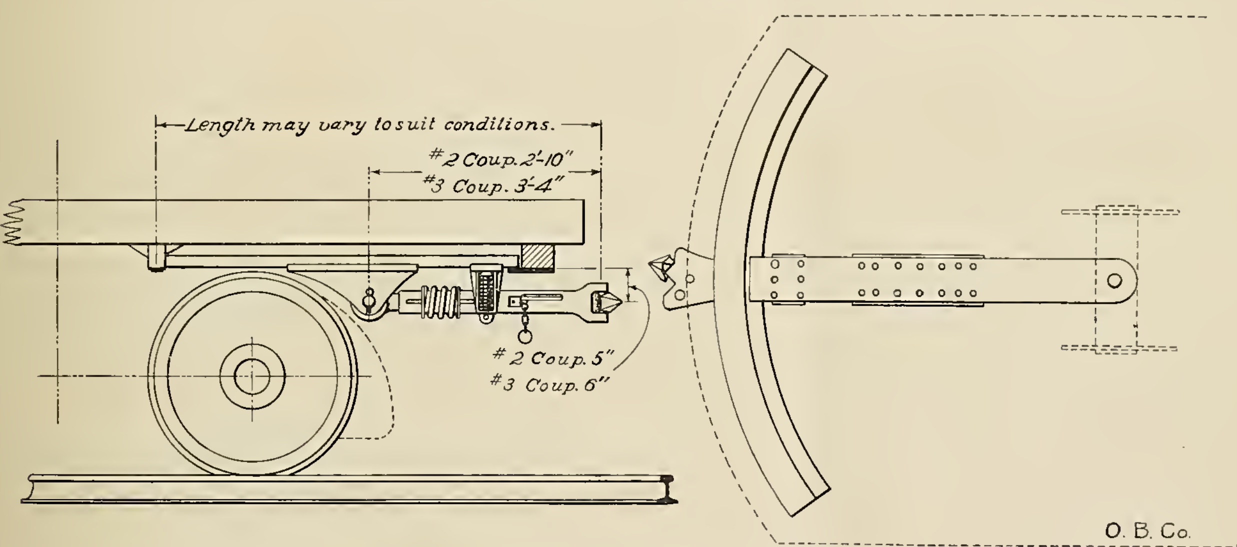


FIG. 12. SHOWING ADAPTABILITY OF TYPE A, FORM 4, COUPLER AND DROP DRAFT GEAR TO REQUIREMENTS OF VARYING CAR DIMENSIONS.

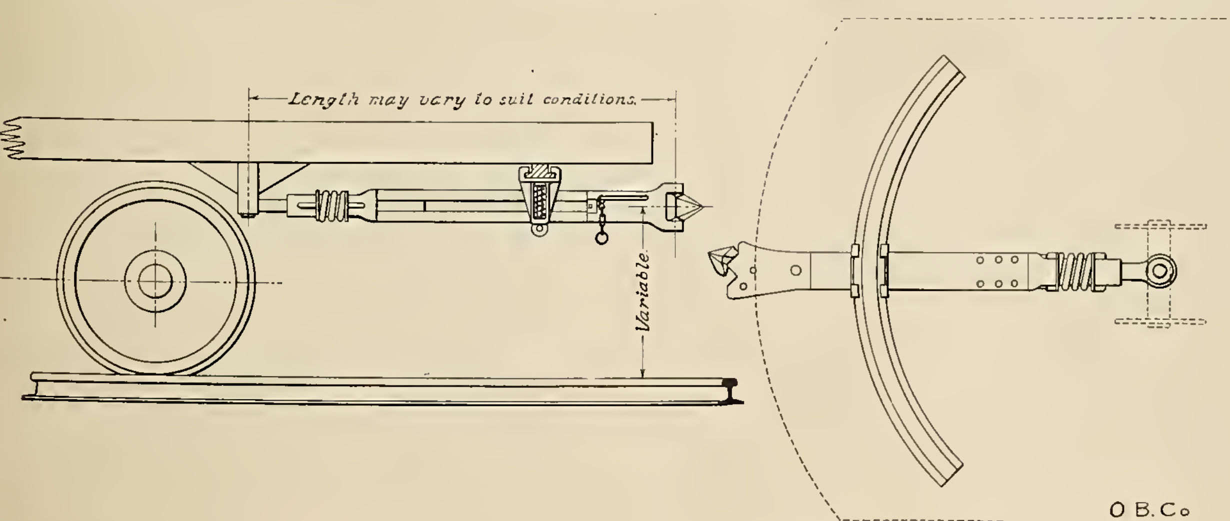


FIG. 13. SHOWING TYPE A, FORM 2, COUPLER WITH SPRING HANGER AND CLEARLY ILLUSTRATING ADAPTABILITY OF THE TOMLINSON COUPLER TO VARIOUS CONDITIONS OF SERVICE.

NEWS NOTES

TRANSPORTATION.

Bisbee, Ariz.—The branch of the Warren-Bisbee street car line, which will connect Bisbee with grounds of the Warren District Country Club, will soon be under way. It will be one and one-half miles long.

Stockton, Cal.—Unless the management of the Central California Traction Company withdraws its demand that all motormen and conductors furnish bonds indemnifying the company against loss through accidents, the employees of the entire system will walk out and tie up both the interurban and local lines.

Reno, Nev.—City Electrician Caffrey, of this city, states that the Virginia & Truckee Railroad Company is contemplating the plan of running all trains by electricity, and have asked him for estimates in regard to the cost of operating two trains each way between Reno and Virginia City each day, and several trains between Reno, Carson, Steamboat and other points.

Redding, Cal.—The franchise of the Redding & Red Bluff Railway Company was revoked by the Board of Supervisors, the time in which the work of construction was to begin having elapsed. The Red Bluff & Redding Railway Company is subsidiary to the Northern Electric. There will be no trouble to get a renewal of the franchise when the company is ready to begin work.

Oakland, Cal.—The need of additional cars for the Key Route has necessitated the increase of the working force at the car-shops on Hollis Street, by fifty men. The additional men went to work Monday morning. Many of them are men who had been laid off during the winter because of the slackness of work. The need of more cars for the Key Route had long been felt by the operative department.

Santa Ana, Cal.—A proposition to build a railroad from Tustin, through this city, across the Santa Ana River and through rich peat lands to Huntington Beach, was made recently by N. A. Ulm, and the Merchants and Manufacturers' Association gave its endorsement and ordered that a committee be appointed to secure subscriptions to stock. The line will be built by local capital, and will be operated independently. It will cost $150,000.

Stockton, Cal.—The first decided step taken to construct a road through the rich Manteca, French Camp, and Ripon District, to the south and east of Stockton, was taken, when articles of incorporation of the San Joaquin Investment Company were filed, with a Board of Directors composed of half a dozen prominent ranchers or property owners in the various localities through which the road will pass. One of the principal objects of the corporation is to secure rights of way for the electric road which will be built by the Central California Traction Company, with the assistance of the land owners and shippers along the route. The traction officials have been anxious to build to Modesto through the most thickly-settled portion of San Joaquin County, but could not see their way clear to pay fancy prices for rights of way. The farmers have taken up the matter, and indications are that work on the new road will be commenced early this summer, and while it may not be possible to complete the road to Modesto this year, it will ultimately be finished to that point.

TELEPHONES.

Mullan, Idaho.—Two ordinances were introduced asking for franchises for telephone lines, one being from the North Idaho and the other from the Interstate Company. The ordinances were laid over until next meeting.

Vancouver, Wash.—Moore & Harden, general contractors, were awarded the contract Saturday, March 7th, for the Home Telephone building for this city. Goodrich & Goodrich of Portland, are the architects.

Whitefish, Mont.—At the town election to be held on April 6th, the proposition of granting a telephone franchise to Carl Green will be passed upon by the voters, the franchise having been approved by the Town Council.

Montesano, Wash.—The petition of J. A. Phillips et al, for permission to construct a telephone line from Western to Markham along the Johns River road was granted, said telephone line to be so constructed as not to interfere with public travel on the road.

Cheney, Wash.—A deal was consummated Saturday by which Charles P. Lund of Spokane becomes the owner of the telephone system of this town, buying the same from William T. DuBois. For many years the exchange was owned and operated by the Pacific States Company.

Stevensville, Mont.—A city telephone exchange is to be installed in Victor within the next four months, and several independent rural lines are to be strung out from Victor to various places in the country tributary thereto. The exchange will be put in by the Rocky Mountain Bell Telephone Company, and the independent rural lines will connect with the Bell Company's wires in Victor.

Wallace, Idaho.—"We have our telephone line constructed as far as Lane, and are making a mile a day. Within thirty-five days we shall be to Wallace, and shall come right into the city and establish an exchange and enter business, regardless of the fact that we have not been granted a franchise." This was the statement of J. E. Markwell of Spokane, one of the officers of the Interstate Telephone Company, which recently applied for a franchise in Wallace, and which franchise the City Council tabled for five months.

Seattle, Wash.—The residents of Vashon Island will be placed in communication by telephone with Seattle within a fortnight. The submarine cable between Vashon Island and Tacoma will be laid by the end of the present week, and the Seattle line will be in working order a week later. The Farmers' Mutual Telephone Company, of which C. S. Wiley of the Title Trust Company, Seattle, is president, has 150 subscribers on Vashon Island. The line will be connected with the Seattle Independent Telephone Exchange.

Nez Perce, Idaho.—The Sunrise Telephone Company passed into the hands of the Nez Perce Co-operative Telephone Company and line connections were established. The Sunrise Company is a farmers' line running seven miles east of Nez Perce. At present fifteen farmers are served, but the line will be extended this spring. The Nez Perce Company, which is a mutual company composed of Nez Perce business men and farmers, has been active in acquiring farmers' lines, a fact which is shown by the addition of 150 instruments already connected.

FINANCIAL.

San Rafael, Cal.—By the issuance of $2,000,000 of bonds of the Marin Water & Power Company, which President A. W. Foster declares will be voted by the stockholders April 7th, new mains will be laid and a big reservoir built.

Petaluma, Cal.—There was delinquent but 144 shares out of 10,000 in the recent assessment of $10 per share on the Petaluma & Santa Rosa Railroad Company. The money goes to pay off the floating indebtedness. About $25,000 will be spent in new equipment.

Oakland, Cal.—The following table shows the gross earnings of the Oakland Traction Company for the last five years: 1903, $1,137,041.19; 1904, $1,258,135.65; 1905, $1,441,470.84; 1906, $2,226,017.11; 1907, $2,789,684.95. The surplus of the company for the past five years, after all charges of every character have been paid, was as follows: 1903, $268,381.92; 1904, $280,325.01; 1905, $308,148.87; 1906, $824,620.14; 1907, $848,881.25.

San Francisco, Cal.—The annual report of the Pacific Telephone & Telegraph Company for the year ending Dec. 31, 1907, showing the remarkable increase of $1,491,949 in gross earnings, equal to 19.3 per cent, reflects the full recovery of the system from the San Francisco disaster, and the growth of the telephone along the Pacific Coast. In point of capitalization and subscribers, this company is second in size to the New York Telephone Company, among the subsidiaries of the American Bell. During the year 1907 the company increased its bonded indebtedness by $8,750,000. Out of this it reduced its large floating debt by only $297,455 to $8,360,950 and established reserve accounts, amounting to $1,065,901, showing a cash expenditure in plant, real estate and equipment of $7,386,644. For this expenditure the book value of the plant, real estate and materials were increased in the balance sheet $6,826,550 to $36,690,538. The increase in the ratio of expense and charges to gross is due to the $10,000,000 of five per cent bonds sold in January, 1907. The gross receipts per station continue very low, about $15 below the average of all the Bell companies, due to the low rates maintained by the company and the rapid growth of the system.

TRANSMISSION.

Alamogordo, N. M.—M. H. Fisher, who will build the new central electric station in Alamagordo, has awarded the contract to the Alamo Development & Construction Company. Engineers of the company are already engaged in putting in the concrete foundations for the machinery.

Myrtle Point, Ore.—The Coquille Valley Power Company has its plans ready for a power plant at the head of Brewster Valley, development of which will give Coos County a light and power system with a capacity of 4,000 horsepower minimum. Water will be flumed for a distance of about 5,000 feet, when it will be given a 300-foot fall through a pipe line to the power house. The company has secured a three-acre site for a power house and 120 acres for reservoir site. Power will be transmitted to Myrtle Point, Coquille, North Bend, Marshfield and Bandon. A substantial power house will be built. There will be two units in water-wheels and two electrical units, being in duplicate.

Redding, Cal.—Harry L. Shannon has located 2,000 inches of the waters of Bear Creek, fifteen miles southeast of Redding. The water is to be diverted through a canal to a power-house site, where electrical power will be developed. Mr. Shannon was the organizer of the Northern California Power Company, and later of the Shasta Power Company, both of which are now delivering light and power in Redding and elsewhere. He is not now connected with either company. He says his location on Bear Creek is in good faith, and he will soon have another power company in the field, making the fifth in Shasta County. The other two are the Pacific Power Company and the Northern Light & Power Company.

Prescott, Ariz.—The Arizona Power Company has begun construction work. Mr. F. S. Viele, president of the Electric Operating Construction Company, who financed the plant, has been in the city for a few days, after having spent two weeks on the site of the plant in Arizona. Mr. M. A. Viele, of the firm of Viele, Blackwell & Buck, of New York, consulting engineers, also went over the work, and they have approved the plans for construction. Mr. R. S. Masson, representing the Electric Operating Construction Company, managers of the Arizona Power Co., is leaving to-night for Prescott, with Mr. H. A. Barre, also of that company, to take up the actual construction. Work will be rushed to a conclusion as rapidly as possible, and it is expected that power will be turned on within ten or twelve months.

OIL.

Santa Maria, Cal.—The Orange Oil Company has struck a large output at its new well, half a mile northwest of the Menges Oil Company property in Brae Canyon and on the north side of La Habra Valley. During the past few days it is reported that it has produced over 3,000 barrels of good gravity oil. The Hall Oil Company has secured territory near that of the Orange Company, and will put down a test well. The property which has been in the possession of the Japs in that section has recently passed into the hands of a private company, which will drill for oil.

San Francisco, Cal.—The report of the Associated Oil Company of San Francisco for the fiscal year ending December 31st, last, which has just been issued, compares with the previous year as follows: Gross income, $10,245,711, an increase of $3,735,924; expenses and taxes, $8,043,363, an increase of $3,852,814; net income, $2,202,348, changes decrease $116,890; interest on bonds, $144,354, changes increase $65,411; balance, $2,057,994, changes decrease $182,301; depreciation, $355,292, changes increase $126,540; surplus, $1,602,702, changes decrease $308,841.

Red Bluff, Cal.—The amount of fuel oil shipped into Red Bluff and consumed by the railroad company for its motive power last year, was very large. Statistics have been compiled for the year ending January 1, 1908, showing that a total of 802 carloads of oil had been emptied into the 55,000-barrel storage tank on the Duncan Hill, from which the 30,000-barrel tank on Madison Street receives its supply. An average of 1,075 locomotive oil-tanks were filled each month during the year at the Red Bluff oil stations. Orders lately received from the general office indicate that extensive improvements in the oiling plant are soon to be made.

ILLUMINATION.

Mendocino, Cal.—The Point Arena Electric Light Plant is to be improved by installing an oil-burning apparatus.

Banning, Cal.—A gas plant will be installed here within the next three months, with a capacity sufficient to furnish light and heat for the town. Local capitalists are back of the project. The company has been incorporated. The contract for installing the system has been let to J. R. Thompson, of Los Angeles.

Seattle, Wash.—Bids have been opened by the Board of Public Works for copper wire for the municipal lighting plant. There were seven bidders, and their quotations were all the same. The specifications call for bids on two grades of wire, one a total of 250,000 pounds, and the other a total of 398,000 pounds. It was decided to use the heavier grade of wire, and the contract will be let at the next meeting of the Board. The total cost of this material will be $64,078.

Nogales, Ariz.—Guallermo Dominguefi, of Los Angeles, who is here, states that within a year from next April a gas manufacturing company, equipped to use fuel oil, will be erected in Guadalajara, Mex., to cost $300,000. H. N. Session, of Los Angeles, will draw the plans. An effort will be made to secure oil from either the Mexican Petroleum Company or the Pearson interests. If this cannot be done it will be imported from California, through Port Manzanillo.

Lakeport, Cal.—The Lake County Electric Power Company has had the Kelseyville natural gas subjected to thorough chemical tests and analyses, and finds it not altogether suitable for power purposes. It contains so large a percentage of carbon dioxide (64.3), and so small a percentage of methane (35.7) that its use as a fuel for power purposes on a large scale will not be profitable. This fact has caused the company to drop the "gas mound" proposition. B. H. Henderson, on his own responsibility, has leased the property, with an option to purchase, and will continue the distribution of gas to the people of Kelseyville for fuel for domestic use. There is plenty of natural gas in Lake County, extending over a belt twenty-five miles long, and some of it runs as high as ninety-eight per cent in methane. The necessity of developing other gas fields will delay the company's operations somewhat, but it is going ahead along other lines. The first contract for poles, enough for eight miles of the line, is almost completed, and another and larger contract will soon be let. Part of the poles were delivered along the line some time ago. The others will be left in the woods until the roads are better.

INCORPORATIONS.

Bakersfield, Cal.—The Juanita Oil Company has been incorporated with a capital stock of $100,000 by J. P. Kerr, E. S. Mosher and J. M. Danzeger.

Los Angeles, Cal.—The Pacific Petroleum Company has been incorporated with a capital stock of $100,000. The directors are M. H. Whittier, H. B. Lee, John Wootan, E. T. Stoddard and C. B. Anderson.

San Francisco, Cal—The Elk Horn Oil Company, with a capital stock of $2,000,000, has been incorporated by L. E. Goble, T. O. May, F. M. Graham, A. Y. Chamberlin and J. G. Jury. The place of business is San Francisco.

Oakland, Cal.—Articles of re-incorporation for $1,000,000 have been filed by the Suburban Light & Power Company. The directors are Charles A. Jeffery, R. W. Geisenhofer, L. B. Smith, William Lucio, A. J. Lloyd, Jacob Harber, Jr., and J. W. Burge. The principal place of business will be in San Leandro.

Los Angeles, Cal.—The Southern California Gas Circuit Company has been incorporated with a capital stock of $500,000 by president, Berthold Baruch; vice-president, Herman Cohn; second vice-president, James W. Hellman; treasurer, M. A. Newmark; secretary and counsel, Samuel T. Mock, all of Los Angeles. The object of the company is to supply gas to Hollywood and Sherman, together with the section between Glendale and Hollywood. The generating plant will be located between Colegrove and Sherman.

TELEPHONE AND TELEGRAPH.

Ukiah, Cal.—Permission has been granted by the Board of Supervisors to F. W. McCracken, to erect a telephone from Ukiah to Redwood Valley.

Napa, Cal.—The Pacific States Telephone & Telegraph Company has leased to the Northwestern Electric Company its local and rural lines at Calistoga, reserving the long-distance business. The Pacific States Company claims that local business in small towns has long been a losing proposition to it, and recently leased to the same company its lines in several of the smaller towns in Sonoma County. The Northwestern Electrical Company last week bought the lines of the Calistoga and Clear Lake Telephone Company, which takes in all of the springs resorts in Lake County. A new $30,000 switchboard has been ordered for this city.

Washington, D. C.—Cable communication with Alaska has been restored. The Alaskan-Valdez cable, controlled by the Signal Corps of the Army, which was broken several weeks ago, supposedly by an earthquake, has been repaired by the Army cable ship "Burnside," and business has been resumed. The Alaskan cables are doing an enormous business. Captain Alexis E. Jennot, Thirteenth Infantry, detailed to the Signal Corps, will leave Washington in May, to begin active operations in the construction of the three big wireless telegraph stations of the United States Army Signal Corps in Alaska. One of these stations will be at Nome, one at Fort Gibbon, and the other at the eastern end of the mouth of the Yukon.

POWER AND LIGHT.

Juneau, Alaska.—The Council, at its meeting last night, granted a franchise to the Juneau Electric Light Company for a term of fifty years. The rates of the company were attacked by local people, but the franchise was granted, nevertheless. A movement is on foot to have injunction proceedings brought to prevent the franchise from becoming operative.

New Westminster, B. C.—Gilley Bros. have been granted a record of 100 inches of water from an unknown stream emptying into Pitt River, on the west side, through the N. S. one-quarter section of Section 22. The water will be used for generating power for crushing rock at the concern's Pitt River quarry. At present the rock-crushing is being operated by steam power.

Bellingham, Wash.—A hydraulic engineer of Denver, Colorado, visited the upper Skagit last week and investigated the water power above Marblemount. It is reported that he represents Denver capitalists who contemplate developing this power during the coming season. The water right on this section of the river was filed on two years ago, the supposition being that the location was being made for Stone & Webster. Another party of Denver men is expected to arrive there within the next two weeks. The filing covers the gorge of the Skagit, twenty-five or thirty miles above Rockport.

THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MARCH 28, 1908 No. 13

PROJECTED SUSPENDED RAILWAY IN BERLIN.

By MAX A. R. BRUNNER.

In Berlin there are about 120 street car lines, thirty omnibus, a steam metropolitan railway, and a combination elevated and underground electric railway, opened in 1902. Yet these agents are not sufficient to carry the crowds. During the past thirty years the population has increased three-fold, while the traffic increased twenty-four times. Another underground railway in the heart of the city is almost completed, and others are projected. But the chief requirement is to have a line extending from north to south, as all other railways go west to east.

This short piece has recently been completed, and is illustrated herewith. The track is supported by full girders, consols, and single posts. The structure is simple and does not take away as much light and air as an elevated railway would do. The track support will be changed according to localities. In wide streets or squares, fork-shaped posts with two legs in the lower part will be used. The height of the rails will be above the third story of an average building, and the cars will thus run above the metropolitan and elevated railway, which is to be crossed several times.

TRIAL STRETCH OF SUSPENDED RAILWAY, BERLIN.

Such a line runs through a densely populated district, where an elevated railway is almost impossible without disfiguring the streets, and an underground system would cost too much. The only solution seems a suspended line similar to that in Elberfeld-Barmen, Germany, the only railway of its kind in the world. When the company owning the patents for this type submitted the plans, the Berlin magistrate ordered a model made in miniature, showing how the new line would alter the appearance of the streets. The firm opened a prize competition for the leading artists and architects to design posts and track which would answer the esthetic and hygienic requirements of such a modern city as Berlin. The result of this contest was a public exhibition, and thereupon the magistrate gave its consent for a provisional trial stretch to be erected in the narrowest portion of the proposed line.

On top of the cars will be wheels similar to mono-rails, which require very few metal parts, in contrast to the heavy trucks of other railways. Thus much weight is saved, or the car body can be enlarged to increase the capacity of the line. Very sharp curves can be taken, without reducing the speed. This facilitates laying out of the proposed line and shortens the time of travel. On curves, the cars will right themselves, and it is impossible that passengers be thrown against the walls. The Elberfeld line has been running several years, and the public has praised its smooth running. A derailment has never taken place. The wheels cling to their rails, and even if one breaks, the remaining three and the hooks hold the hanging car. The whole electric equipment is on the roof, and accessible from a narrow footpath beside the track.

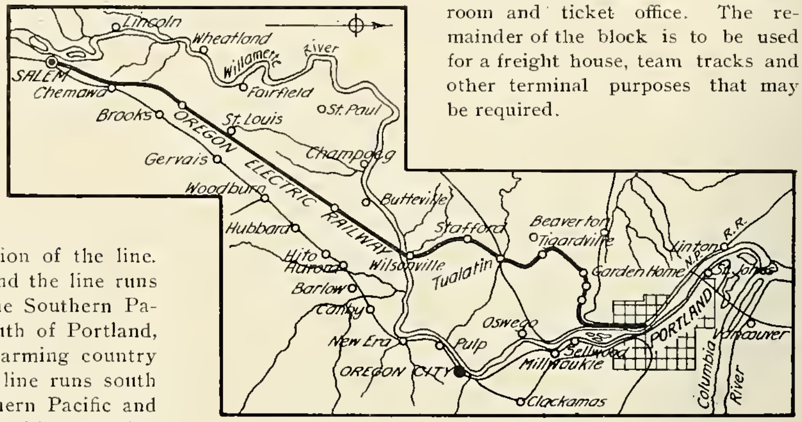
THE OREGON ELECTRIC RAILWAY.*

On February 1st the Oregon Electric Railway Company opened for operation the first portion of its proposed system, an interurban line connecting the cities of Portland and Salem, Ore., a distance of 50.72 miles. The company was incorporated on May 15, 1906, under the laws of Oregon, absorbing at that time the Willamette Valley Traction Company, which held franchises covering part of the present right of way. The capital stock of the company is $10,000,000. During the next few months it is proposed to extend the line from Portland to Hillsboro and Forest Grove, 22 miles. An ultimate extension from Salem up the Willamette valley as far south as Eugene is also contemplated, which will make a total of 135 miles.

The accompanying map shows the location of the line. From the Jefferson Street terminal in Portland the line runs almost directly south, paralleling a line of the Southern Pacific Company to a point about 2½ miles south of Portland, thence turning west through a magnificent farming country to Garden Home. From Garden Home the line runs south again to Tualatin, where it crosses the Southern Pacific and then continues through fertile land to Wilsonville, at which point it crosses the Willamette River on a steel bridge 110 feet above the low water line, thence making a tangent of 19½ miles through small forests and fertile farming country to a point near Chemawa, at which point it again turns south through Chemawa and toward Salem.

traditions of the Indians, this idea will be carried out to a certain extent in the advertising of the road.

As the line ends for the present at Mill Street in the city of Salem permanent terminal facilities at that point are being arranged for. At Jefferson Street, Portland, the company owns an entire city block. On one corner of this block a building has been erected which contains six storerooms, a waiting room, baggage and express room and ticket office. The remainder of the block is to be used for a freight house, team tracks and other terminal purposes that may be required.



OREGON ELECTRIC RAILWAY—MAP OF PRESENT LINE.

Track and Roadway.

The track and roadbed have been constructed throughout in accordance with the highest standards of steam railroad practice. The small number of curves and grades and the

OREGON ELECTRIC RAILWAY—LONG TIMBER TRESTLE ON CURVE NEAR PORTLAND, 100 FEET HIGH.

OREGON ELECTRIC RAILWAY—STEEL DECK BRIDGE OVER THE WILLAMETTE RIVER AT WILSONVILLE.

While the only intermediate towns of any size are Tualatin and Wilsonville, the entire section traversed is a thickly settled farming community, and there will be numerous stations established at cross roads. Under the schedule which was put into effect at the time of the opening of the road there are 21 stations, including the terminals of Portland and Salem. In naming the new stations the management has selected names of Indian origin. Inasmuch as the Willamette Valley occupies a prominent place in the early history of Oregon, especially in connection with the movements and

*Condensed from "Electric Railway Review."

substantial character of the bridges and trestles make it possible to operate with safety at a high rate of speed. The heaviest grade on the line is one of 2½ per cent over a hill just outside the city limits of Portland; none of the other grades exceeds 1 per cent. Including city streets there are only 50 curves and 85 per cent of the track, including a 19½-mile stretch south of Wilsonville, is on tangent. The sharpest curve is 8 degrees.

The track is standard gauge and is laid with 70-pound rails on fir ties. The bonds are of the Ohio Brass Company's "G-D" type. The track is now being ballasted with 2,300 cubic yards of gravel per mile. A large number of cuts and

fills were required. The slope of the embankment on fills is 1½ to 1 and in cuts 1 to 1. There are 38 pile trestles. At Wilsonville the road crosses the Willamette River on a steel bridge of four 200-foot spans, with a total length, including trestle approaches, of 3,800 feet.

Power.

Power for the operation of the line is purchased from the Portland Railway Light & Power Company and transmitted from its power plant at Oregon City to the railway over a 9-mile transmission line, carrying current at 33,000 volts pressure and a frequency of 33 cycles. The current is

OREGON ELECTRIC RAILWAY—19½ MILE TANGENT.

converted to the operating pressure of 600 volts in four substations, equipped with 500-kilowatt six-phase, 600-volt rotary converters and the necessary switchboards and transformers, all of General Electric manufacture. The substation buildings, one of which is illustrated herewith, are of concrete and are 36 by 42 feet in size.

OREGON ELECTRIC RAILWAY — STANDARD LOCAL PASSENGER STATION.

The overhead construction is of the catenary type, the No. 0000 trolley wire being suspended from a 7/16-inch galvanized steel messenger cable, supported by 9-foot, 9-inch T-bar brackets from poles set 150 feet apart on tangent and 100 feet apart on curves. The poles also carry the transmission line and the telephone and telegraph wires. The overhead construction, was supplied by the Ohio Brass Company.

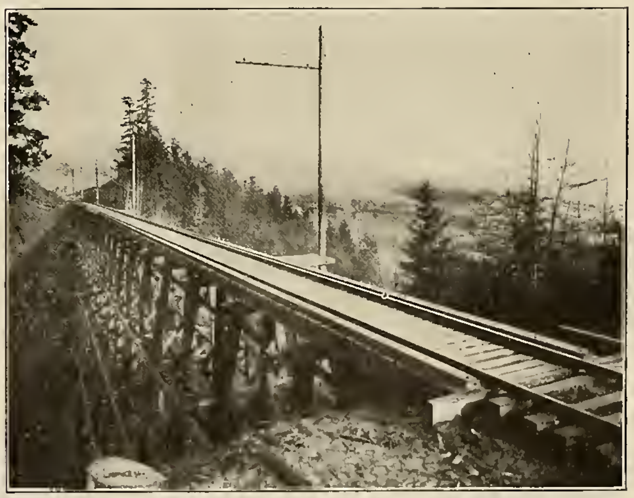
Rolling Stock.

The rolling stock equipment of the new road comprises eight passenger motor cars, two electric freight locomotives, and 15 freight cars. An order has been placed for 25 flat cars and 25 box cars to supplement the other freight equipments. As shown by the accompanying illustrations, the passenger cars are large equipments of an especially pleasing design.

OREGON ELECTRIC RAILWAY—STANDARD CONCRETE SUBSTATION.

These cars were built by the Jewett Car Company, Newark, O.

The length of the car from bumper to bumper is 57 feet 8 inches. The car body is 9 feet wide over posts, and when mounted is 13 feet 7¼ inches high from rail to trolley board. The interior of the car is divided into three compartments: a baggage compartment with four folding seats, a smoking compartment with four fixed and four reversible seats, and a general compartment with three fixed and sixteen reversible



OREGON ELECTRIC RAILWAY—LONG TIMBER TRESTLE NEAR PORTLAND.

seats. The toilet compartment occupies a corner next to the rear door. As the cars are arranged for single-end operation the motorman will be entirely shut off from the passengers. His cab is provided with a 24-inch door on one side only. The baggage compartment has two sliding side doors each 3 feet 6 inches wide. The doors in the interior partitions and in the rear bulkhead swing on hinges.

Each car body is mounted on Baldwin heavy M. C. B. type trucks with steel wheels and Symington journal boxes.

Each car is equipped with M. C. B. coupler heads and one locomotive pilot. The electrical equipment on each car includes four 75-horsepower General Electric motors with multiple-unit control. The brake equipment is the Westinghouse Traction Brake Company's A. M. R. schedule with quick-acting rtiple valve, quick recharge, quick service and graduated release features. A No. 3 direct-current air compressor and a slack adjuster are included in the brake equipment. The cars are equipped with De France air sanders. The locomotives are double-ended, of 50 tons weight, and are equipped with two 160-horsepower General Electric motors and pantagraph current collectors.

A 60 by 135 foot car house is located at South Portland, and a smaller one at Salem.

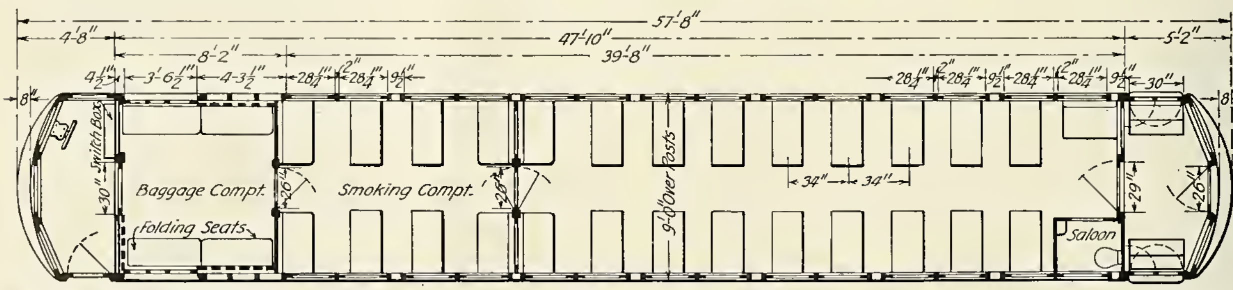
Operation.

Trains are to be operated in accordance with the standard code of rules of the American Railway Association. All signals, markers, etc., will also conform to those in general use on steam roads. The dispatchers' office is located at Portland, and standard telegraph train orders will be used. A telephone line has also been provided for use as an auxiliary. The policy of the company is to insist on good and regular service. The dispatching system has been very carefully arranged, and all trainmen who enter the service are required to pass a thorough examination in the rules of the American Railway Association besides a rigid physical examination.

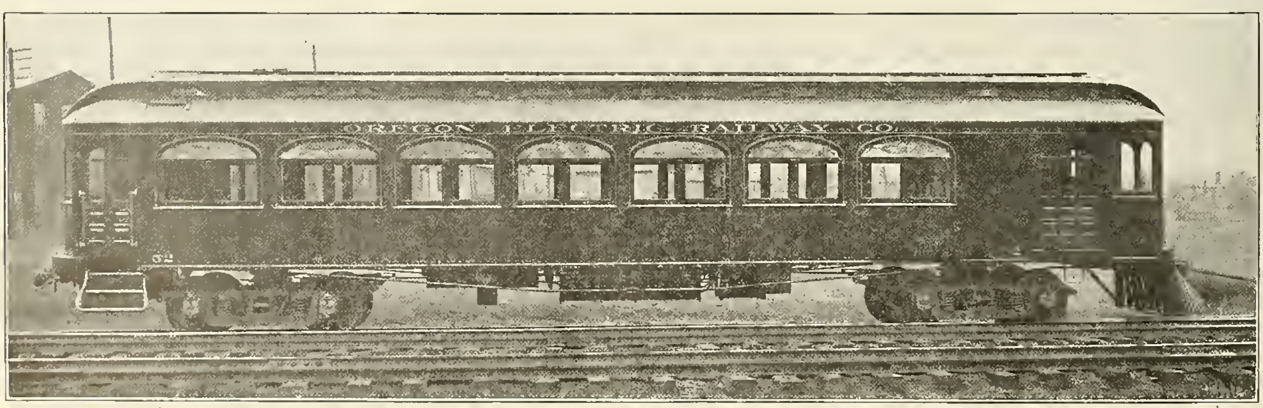
As soon as the ballasting is completed the company will establish a schedule of 10 trains per day in each direction between Portland and Salem. Three trains in each direction will be limited trains making no stops between terminals. It is expected to make the running time of the limiteds 1 hour and 30 minutes, and of the locals 2 hours and 10 minutes. At present 1-car trains are used, but it is planned to eventually operate multiple-unit trains of two and three cars each.

The construction of the road was in the hands of the Willamette Construction Company, a construction organization of the engineering firm of W. S. Barstow & Co., of New York and Portland. R. L. Donald was chief engineer in charge, and F. S. Drake superintendent of construction. The officers of the Oregon Electric Railway are: President, George Barclay Moffat, New York; vice-president and general manager, Guy W. Talbot, Portland; secretary, traffic manager and auditor, George F. Nevins, Portland; assistant secretary, Francis C. Schwab, New York; treasurer, Henry W. Brower, New York; assistant treasurer, C. H. Still, Portland; superintendent, C. A. Coolidge, Portland.

OREGON ELECTRIC RAILWAY — TRANSMISSION BRACKET AND CATENARY CONSTRUCTION ON CURVE.



OREGON ELECTRIC RAILWAY—FLOOR PLAN OF 3-COMPARTMENT PASSENGER CAR, SHOWING SEATING ARRANGEMENT AND PRINCIPAL DIMENSIONS.



OREGON ELECTRIC RAILWAY—SINGLE-END PASSENGER CAR WITH THREE COMPARTMENTS.

FRANCIS TURBINE DETAILS.

By W. F. Uhl, Engineer, Hydraulic Turbine Department, Allis-Chalmers Company.

Your editorial and articles in your issues of February 29 and March 7, we believe justify us as builders and designers of both impulse and reaction turbines. It may be interesting to know that from our point of view as manufacturers, the impulse turbine is far more preferable, as for the same conditions in most cases this type is much more expensive than the reaction type, therefore, contract price would usually be much higher. However, from an engineering standpoint we have learned that up to the point reached at this writing the higher the head under which the reaction turbine has been put in operation, the better the results. Up to date the writer has designed or has been intimately connected with the design and operation of 83,200 horsepower of high pressure reaction turbines, ranging in size of units from 875 horsepower capacity to 13,500 horsepower capacity, and operating under heads from 270 to 550 feet, and in connection with pipe lines ranging in length from 500 feet to 5 miles, the water in them having a velocity of as high as 25 feet per second.

The points which seem to have been given most consideration by the various engineers who discussed the 9,700-horsepower Centerville turbine are as follows: Purchase price, regulation, efficiency, dirty water, economy and maintenance. We will try and take up these various points, giving our experience regarding them, but we do not maintain that other engineers may not have had contrary experiences.

Purchase Price.

The price of the turbine, governor, pressure regulator and generator suitable for the conditions under which the Centerville turbine operates is approximately $37,000, f. o. b., works. It occupies with its auxiliaries and generator, a floor space of 420 square feet. It is a well known fact that the efficiency of the turbine depends upon the specific speed or the speed for unity head per unity of power. Impulse turbines having the same relative specific speed as the Centerville reaction turbine which has a speed of 400 revolutions per minute would require four nozzles of 7 inches diameter jet each. Since it is mechanically inconvenient to use more than two wheels for one unit, and inefficient to use more than one jet on each wheel, with horizontal units, we would require two units for the same output. With the given specific speed each unit would have a speed of 200 revolutions per minute. The price of two such units of the deflecting nozzle type with suitable governors and generators is approximately $60,000, and the floor space occupied is 1,800 square feet. If the reaction turbine is operated with the pressure regulator used as a synchronous bypass, giving the same results as the deflecting nozzle, the economy of the turbines is practically the same, but the hydraulic efficiency is in favor of the reaction turbine. A correctly designed pressure regulator can be arranged to vary its discharge the same as a hand-operated needle nozzle.

Regulation.

The type of turbine has absolutely no effect upon the regulation of the speed of a hydro-electric unit. When the pressure regulator operates as a synchronous bypass the velocity of the water in the pipe line will be constant, as with a deflecting nozzle impulse turbine, and the regulation depends upon the governor and the flywheel effect only. If the governor is of proper design, its regulation depends entirely upon the flywheel effect of the rotating masses, the same as with a steam or gas engine. If the pressure regulator is used automatically so that it will only open for certain predetermined changes of load (as a well designed pressure regulator must operate), the regulation depends also upon the pressure increases and decreases in the pipe line. But these conditions again remain the same with a reaction turbine as with an impulse turbine, providing the impulse turbine also has automatic pressure regulators. Every impulse turbine which is to operate as economically as the reaction turbine must have for the same length of pipe line. There is no reason why pressure regulators should not be used with impulse turbines as well as with reaction turbines. There is no excuse for the deflecting nozzle impulse turbine unless it is necessary to pass the same amount of water regardless of load as may be the case where power plants are operated in conjunction with irrigation projects, or where it is impossible to provide a suitable standpipe on an exceptionally long pipe line.

Efficiency.

From tests so far made on a suitable number of impulse and reaction turbines of numerous makes, we are satisfied that the reaction turbine has the advantage of at least three to four per cent with heads from 200 to 600 feet. What higher heads will produce is yet to be determined, but indications are in favor of the reaction turbine. With an exceptionally well designed impulse turbine 82 to 83 per cent may be obtained as against 85 to 86 per cent with the reaction type. The maximum point of efficiency can be arranged to occur at half gate as well as at full gate, and the efficiency is not necessarily the best at normal gate opening.

Dirty Water.

When the first reaction turbines were built it was assumed for no apparent reason, that dirty water would wear out the turbine parts rapidly. This assumption has proven erroneous, and such parts as have so far shown wear, have been proven to be defective in design, and the wear was in no case due to dirty water. That this should be the case may be readily seen from the fact that the highest velocity the water reaches in a reaction turbine is about 0.67 $\sqrt{2gh}$, whereas with the impulse turbine the water reaches a velocity of 0.95 $\sqrt{2gh}$. Furthermore, any debris which can pass through the nozzle of an impulse turbine can certainly pass through the reaction turbine.

Economy.

If both types of turbines are provided with automatic governor actuated pressure regulators, the economy should be the same, but with the pressure regulator used as a synchronous bypass on the reaction turbine, it is more economical than the deflecting nozzle type, since the bypass can be arranged to be automatically adjustable, whereas the needle must be operated by hand.

Maintenance.

A reaction turbine, due to its construction, is much more adaptable to good substantial mechanical design than either the deflecting nozzle, hand-regulated needle type, or the stationary nozzle type with governor actuated needle and pressure regulator. There is no excuse for any part of a reaction turbine breaking since there is no part where it is necessary to use a small factor of safety to gain small weight. The design of the runners themselves is very compact and solid in one piece, with no parts being held together by bolts, whereas the impulse turbine wheel has many component parts, and it is a noteworthy fact that many wheels have broken with disastrous results.

Regarding multiple nozzle impulse wheels it is not possible to make a good design with more than one nozzle for a single horizontal unit. With vertical units, it is possible to

make a number of nozzles to one wheel, but this brings into question the thrust bearing, and the higher the speed the less desirable is the thrust bearing of the vertical type, since the rotating parts cannot be balanced as is possible with the reaction turbine.

Oil lubricated thrust bearings give no more trouble than a ring oiling horizontal bearing but their sphere of usefulness is limited and our experience will not permit us to recommend oil pressure thrust bearings. They are unreliable, and a spare unit must be at command at all times; furthermore, the maintenance of an elaborate oil pumping system, which must be in duplicate to be safe, is an item which often means the difference between dividends on an investment and the failure of it.

Draft tubes for impulse turbines, or for that matter, with any type of turbine other than the reaction turbine have not proven a success, and as far as we know, they are a waste of money. A properly designed draft tube with a reaction turbine, although not necessary, provides for a change in the tail water level, and since it is necessary to place the lowest point of impulse wheel above the highest tail water, which occurs usually for only one or two days in a year, a large percentage of the total head is lost at all times, since the head water almost always varies with the tail water, leaving the total head the same. The head usually lost with an impulse turbine is about 20 feet. For the same amount of water, therefore, under 550-foot head we lose 300 horsepower on the 9,700 horsepower turbine, which, at $30.00 per horsepower, per year, means a loss of $9,000.00 net.

When buyers forget to forget; when competition ceases to compete; when every actual and prospective customer has been convinced that your product is the best of its kind and nothing better can be produced, then, and only then, will it be safe to get along without advertising.

Just so long as old buyers die and new ones take their places; just so long as there is competition to coax your customers from you; just so long as there is a possibility that somebody else will produce a better product, just so long will it be important, absolutely necessary, to carry on the work of educating and reminding your own and your competitors' customers as to your goods.

And just so long as the buyers and prospective buyers in a given trade or profession subscribe to the publications representing that trade or profession, just so long will there be no better way to reach and impress them with your business story, than through the technical and trade publications which they look to and depend upon for the information which enables them to compete successfully along their own lines.

Is it not quite as necessary to do this work of educating and reminding in dull times as when business is brisk? It takes time, at any time, to excite interest and create desire; new men are coming into your business field every day; there is always plenty of worth while material to work on. Where, then, is there any saving in the temporary discontinuance of a work which must be done—which must be done more and harder and at greater cost if once interrupted?—Selling Magazine.

ELECTRIFICATION OF RAILWAYS.

By Dr. Gisbert Kapp.

(Continued.)

Switzerland.—As regards lack of coal and abundance of water power, Switzerland is very much in the same position as Italy, but the condition of its railway service is somewhat different, as nearly all roads are very hilly, very high speeds are not required, and summer tourist traffic is of greater importance than elsewhere. In the beginning of 1904 the Swiss Government called together a committee of experts, and instructed them to report on the electrification of the whole of the Swiss railways, which meanwhile have become State property. There is in Switzerland a growing tendency for the nationalization of the more important water powers, and an apprehension that by the time the Government is ready to electrify the railways there will be no water powers left out of private hands. Hence the committee was instructed first of all to ascertain what amount of power will be required for the railway service, so that the Government may secure the necessary powers ere it be too late. Besides Swiss railway officials and Prof. Wyssling, who acts as general secretary, the committee contains representatives of the large Swiss electrical firms and the societies of electrical engineering and central stations. The reference for the labors of this committee is as follows: (1) What power is required for electrifying all Swiss railways; (2) report on the various systems of electric traction; (3) give a list of those water powers which could be utilized; (4) give capital cost and annual working expenses; (5) establish standards for electrification. The committee has issued an interim report dealing with the first reference. It is still working, and further reports may be expected during this year. The demand for power has been calculated on the basis of the actual goods and passenger traffic on the busiest day in summer and winter. In making the calculation for every train the profile of the line and the energy wasted in starting were taken into consideration, the air resistance was calculated from Barbier's formula corrected by the results of the Zossen trials, and no pains have been spared to get accurate results. The summer traffic is, of course, heavier than the winter traffic, but in winter the energy for heating and lighting has also to be supplied. Both together amount on the average to 13 per cent of the energy required for traction. The energy that has to be supplied per day per passenger for heating has been found from experiments on the Frieburg-Murten Railway (where the coaches are electrically heated) to be 1,100 watt-hours. For lighting the daily energy is only 230 watt-hours per passenger seat, the low average being due to the fact that, with the exception of the Gothard, there are no lines on which passenger trains run the night through. To be on the safe side, the committee figured on weight of trains somewhat in excess of those now prevailing in steam traction, but they assumed that the whole service would be by locomotives, not motor coaches. This, although not the most economical, is an unavoidable method of working, since the Swiss lines must take over the International trains as they are delivered

over the frontier from four different countries. The committee also made a very safe estimate as regards over-all efficiency (only 40 per cent), and did not allow anything for recuperation, which is quite a valuable feature on the Valtellina line. Since the system to be adopted is not yet decided, it was, perhaps, as well that recuperation of energy on down grades and slowing up, which is a peculiarity of one particular system, should be left out of account. I merely mention the matter to show that the estimate made is certainly rather above than below actual requirements. Yet the total power required is astonishingly small. The total energy to be developed on the shaft of the turbines in 24 hours is only 2.4 million horsepower hours, or a steady load of 100,000 horsepower. The committee has also reckoned cautiously as regards the overlapping of the demand which may come on to the same power house from various lines. They assume that the maximum demand may be as much as five times the average, and thus they find that the total power of the turbines which will be required in the various power houses will aggregate to 500,000 horsepower. It is interesting to compare with these estimates the amount of energy actually developed by locomotives as far as an estimate is possible from the amount of coal used. The Swiss railways consume annually over three-quarter million tons, or 2,200 tons daily, which corresponds to about 800,000 horsepower hours of tractive energy. The committee reckon 40 per cent of 2.4 million or 960,000 horsepower hours.

Sweden.—This country should prove a promising field for electrification, in so far as it has water power and coal is dear, the price paid by the Swedish railways reaching and exceeding sometimes 22s. per ton. On the other hand, the enormous distances and the low density of population of only 30 inhabitants to the square mile are adverse factors. When one considers that the cost of feeders, sub-station, and electric equipment of the permanent way comes to about £2,000 per mile of track, it is easy to see that the capital outlay and maintenance, although not important items on a line with plenty of traffic, will be a rather heavy burden on lines which have only little traffic. Yet the Swedish Government has made a beginning with electrification. Some years ago it sent its chief electrician, Mr. Robert Dahlander, to the continent of Europe and to America to study the question of working main lines electrically, and on his return in the beginning of 1904 the Swedish Parliament voted £23,500 for experiments on two short lines running out of Stockholm to the northwest and north. At Tomteboda a power house was fitted with two De Laval turbo-generators of 270 horsepower each, producing 500-volt single-phase current at 25 frequency. The generators are arranged for variable speed, so that a frequency of 20 and one of 15 can also be had. Only single-phase current is being used, Mr. Dahlander having come to the conclusion that neither of the other two systems is equally suitable on lines on which, by reason of their great length, a very high pressure in the trolley wire is essential. To lower the pressure and use more sub-stations would on lines with little traffic not be economically justifiable, whilst the higher efficiency of either of the other systems is of little importance in a country where water power is not only cheap, but supplied from lakes which form natural storage reservoirs to be drawn upon for the peak loads. The trolley line is suspended from single and on certain parts from double catenaries. The same posts also carry telephone wires, and it was observed that the latter assumed a potential of 4,500 volts to earth when the trolley wire received current at 20,000 volts. Means had, therefore, to be found to carry off to earth the charge induced in the telephone circuit without interfering with its use as a telephone line. In addition to drilling in the usual way to eliminate induced currents, an electro-magnet with double winding was put at either end as a shunt to the line and the middle point of the winding connected to earth. The self-induction of this magnet is sufficiently great to prevent any appreciable part of the telephonic currents being shunted, whilst static charges flowing to earth through the middle point to the winding, and, therefore, through the windings in opposite sense, encounter no self-induction. The trolley voltage is obtained by step-up transformers in the power house, and the latter are so arranged that by changing the connections of the sub-divided winding pressures varying from 5,000 to 37,500 volts can be obtained. The British Westinghouse Company, the Siemens-Schuckertwerke, and the Allgemeine Elektricitats-Gesellschaft of Berlin have each supplied rolling-stock for this experimental line. The Westinghouse locomotive is adapted to take current at 3, 6, 12, 15, and 18 thousand volts; it has two driving axles each fitted by spur gear with a 150-horsepower motor, and the maximum tractive effort is four tons. The Siemens locomotive is built for a trolley voltage of 20,000 volts; it weighs 36 tons and its maximum tractive effort is six tons. It has three driving axles, and is fitted with three compensated series motors of 110 horsepower normal capacity, the voltage of 350 being obtained by a transformator of 350 k. v. a. output carried on the locomotive. The motors are cooled by air blast taken through a gauze filter to prevent dust getting to the motors. The motor-coach train was supplied by the Allgemeine Elektricitats-Gesellschaft. Each motor coach is fitted with two 120-horsepower Winter-Eichberg motors adapted to take current at 6,000 volts. The gear fitted at present permits of a maximum speed of 28 miles per hour, but other gear wheels have been supplied, so that by putting these on the speed may be increased to 40 miles per hour. The motor coaches are fitted with the usual bow collector, but as it is intended to experiment also with the Oerlikon system, the necessary provision for the Oerlikon rod has been made on the roof of the coach. The regular service by electric traction was started on the Stockholm-Jarfva section on February 23rd of last year, the rolling stock here described being used. Whilst the experiments were in progress the Swedish Government purchased three waterfalls with an aggregate of 24,600 horsepower, which, with the Trollhattan and Elfkarleby Falls already in its possession, will enable it to supply over 50,000 horsepower for railway traction in the southern part of Sweden over about 1,300 miles of line. For this part of the country Mr. Dahlander has worked out complete plans and estimates for electrification. There will be five large power houses, and the water power now in possession of the State will suffice for present requirements, but Mr. Dahlander estimates an increase of 60 per cent in the traffic by 1920, and to provide for this he supplements two of the power stations by steam plant, the fuel being peat. The pressure in the feeders will be 50,000 volts, and that in the trolley 15,000 volts. The lines total up to 1,380 miles, and the single tracks, including sidings, to 2,800 miles. The five power houses will contain steam and water turbines, with a total of 80,000 horsepower, and the cost of the generating plant, including the purchase of water rights, comes to £1,540,000, whilst the cost of feeders, sub-stations, and electric equipment of the permanent way amounts to £2,620,000, so that the total outlay is estimated at £4,160,000. The cost of electric locomotives is not included in this sum. In estimating the cost of maintenance and working expenses, Mr. Dahlander includes locomotive charges. He also assumes that for the present fifty of the existing steam locomotives would be retained as reserves, and that each of these would do about 6,000 miles per annum. The net result of these calculations is that with coal at 22s. a ton the annual saving in 1920 will amount to about £200,000.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MARCH 28, 1908 No. 13

EDITORIAL.

IN SYNCHRONISM.

The alternating currents of some unknown, all-powerful, all-pervading force, by some called Destiny, by others, Divinity, influence man, much as currents of electricity affect a conductor. While in the aggregate it accomplishes much, yet its evidence in the individual is usually slight, and ultimately independent of him. Like the electric current, it is made manifest only by its effects, and is evident only when interrupted.

An electric current causes either heat, magnetism, or chemical action. Analogously affected by this infinite force, man may be heated by the enthusiasm of ambition, contagious to those contiguous. He is, as it were, surrounded with a magnetic field, which induces action in others near him, and causes their lives to parallel that indicated by its direction. As in electrolysis, it is continually changing from the homogeneous to the heterogeneous.

Resistance may divert, but never destroy its power. It cannot be insulated, nor can we plot the characteristic of the Generator. Religion's attempt to explain its working is no more successful than is the calculus in explaining alternating current phenomena to the non-mathematician. Religious madness is often evinced by hysteria, as is residual magnetism by hysteresis.

Recent investigations by Dr. J. Siebel, of Chicago, would seem to indicate that the human body is made up of numberless minute electric batteries. Alcohol, sugar, and fats furnish the positive elements, the alkaline carbonate the negative, which transfer the oxygen from the oxyhemoglobin of the blood to these cells. The electro-motive force set up by them becomes the muscular force of the system. He even proposes to use denatured alcohol and sodium-bicarbonate as the elements for a commercial battery. But these currents are subsidiary, and are dominated by the master force that appears as will power in the individual. Man's efforts to thwart this purpose are often due to the counter electro-motive force of self-induction. He may temporarily shunt it, but is more likely to cause a disastrous short circuit.

Its work is measured by the great march of human progress, as is shown in the meter history, whose dial is illuminated by its manifestation in the lamp of experience.

During any period its apparent direction may be alternated, but at the end there is always advance. It leads with increased capacity and lags with impedance. The reciprocal of impedance is admittance. This polyphase force can be transformed and converted, and it often causes eddy currents.

Its cycles we can trace throughout all the Universe—through the geologic evolution of the earth and of every organism therein; through the evolution of human society, whether religious, political or economical, the latter, however, being psychic as well as cyclic. During the Dark Ages its energy was potential rather than kinetic, being stored in the Latin language as an accumulator, for whose discharge the Church acted as a poorly designed maximum cut-out, until its resistance was overcome by the Renaissance.

If man's belief undergoes no change as his knowledge of its various phases increases, he is as one who will not accept the facts demonstrating the intimate atomic relation between matter and electricity.

The latest theory, that an electric current consists of the displacement of the electrical charges of the constituent atoms, might similarly apply to the currents of this force, except that some are more highly charged with this energy than others. Its transmission is wireless. Both have been likened to a great stream whose sources, while individually small, ultimately unite, one by one, each with the other, to form a mighty river of life-giving power. Or, again, a great hydro-electric system may be compared with the system of human society feeding on to the transmission lines of universal progress, and centrally regulated by a master Governor, just as is the harmony of a great orchestric symphony directed by the leader's baton.

These and all other speculations should be regarded merely as forms in which are molded the reinforced concrete, necessary in construction, but to be removed as the powerhouse nears completion, leaving its grandeur unimpaired by unsightly staging. Certain great truths, slowly evolved through ages past, already stand forth as magnificent window-arches, indicative of the splendor of the building as yet unfinished by this constructive force.

Disregarding the unanswered question of, "What is?," the great riddle of the Universe, man is personally far more interested in the immediate application of this force to his needs. "What shall I do with it?" is the question that each must answer for himself, and upon his utilization depends his success. In connection with this we needs must note the comparatively recent growth of the idea of man's brotherhood. Our limited perspective through the glass of history shows us a period just past, where man was heedless of the welfare of others, particularly of future generations. The beginning of the present cycle indicates an endeavor to remedy this, as is shown by the attempt at conservation of the great natural resources of the earth, man's splendid heritage. We know not what the next cycle will accomplish, but we do know that efficiency is obtained only when man is running in synchronism with the Generator.

TRADE CATALOGUES.

Bulletin No. 384 from the National Brake & Electric Company is devoted to National type "3 V S" air compressor, a single-stage machine with three vertical cylinders, motor driven.

Fort Wayne electric fan motors are illustrated and described in Bulletin No. 1105 from the Fort Wayne Electric Works. They are made in several styles for either direct or alternating current..

H. W. Johns-Manville Co. sends a unique booklet on "Advantages of a Built Up Ready Roofing" requiring no preservative coating. A number of typical installations of J.-M. asbestos roofing are shown.

The Brown Hoisting Machinery Company, of Cleveland, Ohio, sends a well-illustrated catalogue describing "Brownhoist" locomotive cranes with patent grab buckets for handling coal, ore, sand, ashes, etc.

Fort Wayne Electric Works, of Fort Wayne, Ind., send Bulletin No. 1104, illustrating and describing their multiphase belted alternators, form B, which are made with either two or three phase windings, for 2,300, 1,150, 600, 480 and 240 volts, and which can handle motors, series arcs, and incandescents from the same machine at the same time. They are constructed to carry 75 per cent of their three-phase output within the standard heating guarantees when used to supply current to single-phase circuits.

MEETING NOTICE.

The next monthly meeting of The American Society of Mechanical Engineers will be held in the auditorium of the Engineering Societies Building, New York, on the evening of April 14. The general subject of the meeting is "The Conservation of Our National Resources," which is now receiving unusual attention, because of the invitation of the President of the United States to the Governors of the several States, and to the presidents of the National Engineering Societies, to confer with him in Washington on this important problem. The New York meeting will be addressed by four speakers, who will consider forest preservation in its relation to water power, economy in the utilization of fuels, and the attitude of the engineer in regard to these. Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, will be one of the speakers, and will discuss the "Relation of the Engineer to the Body Politic."

PERSONAL.

H. C. Parker has joined the staff of the California Gas & Electric Corporation.

A. C. Garrison, representing the Columbia Incandescent Lamp Company, of St. Louis, has been in San Francisco recently.

Fred C. Finkle, consulting engineer, of Los Angeles, ha gone to Portland, Oregon, as chief engineer for the Mt. Hood Ry. and Power Co., to let new contracts for hydranlic and electric equipment ne essary to complete the work.

G. I. Kinney has succeeded H. C. Parker as the San Francisco representative of the Fort Wayne Electric Works, Northern Electrical Manufacturing Company, and Sprague Electric Company, with offices at 403-405 Atlas Building.

S. P. Russell, Jr., has returned home to take charge of the electrical department of the San Francisco office of H. W. Johns-Manville Co., after an extensive experience throughout the East. We are glad to welcome him back, and know that there is no place where he can be of greater service to his company than among his friends, and they are legion.

M. L. DOWNS, secretary and general manager of the Brookfield Glass Company of New York City, has proceeded from San Francisco to Seattle in the course of his extended visit to the Pacific Coast in the general interests of his company. He leaves behind a host of friends. The report o the prosperity of the West from such influential men as Mr. Downs will do much to restore pnblic confidence in the East.

The American Society of Mechanical Engineers, with the desire to still further develop their publications, have been fortunate in securing Mr. Lester G. French to direct their editorial department. Among the immediate improvements to be undertaken is the establishing of departments in the monthly Proceedings, thus providing a greater variety of technical articles of interest. Many other features are planned, and the aim will be to make the Proceedings of such value that no engineer can afford to be without them. All such papers, however, will first be presented and discussed before the society at its meetings, as formerly, thus benefiting the membership two-fold. Mr. French was born in Keene, New Hampshire, in 1869, and very early commenced his training in editorial work and printing at Brattleboro, Vt., his father having been the publisher for a very long time of "The Vermont Phoenix," and a partner in a large printing establishment in that same place. In 1891, Mr. French received his degree in mechanical engineering from the Massachusetts Institute of Technology. After four years' apprenticeship, drafting-room and shop experience, principally at the Builders' Iron Foundry shops in Providence, and a year and a half as a text-book writer, Mr. French was engaged on the editorial staff of "Machinery," and assisted greatly in the development of that paper, and for nine years was its editor-in-chief. Recently Mr. French re-engaged in the publishing of text-books on algebra, applied mechanics, and of a treatise on steam turbines.

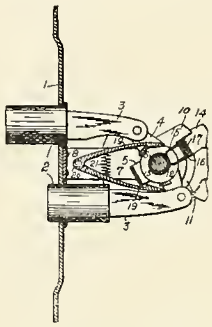
TRADE NOTICE.

The Locke Insulator Mfg. Co., of Victor, N. Y., have appointed as agents for Eastern Canada, the Engineering Equipment & Supply Co., Lindsay Building, Montreal, Canada.

PATENTS

ELECTRIC SWITCH. 881,300. Everett M. Coffin, Oakland, Cal.

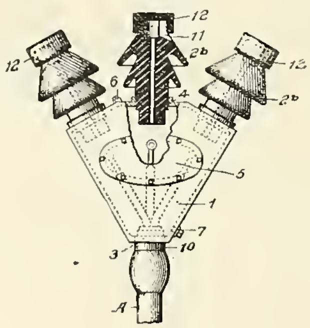
The combination of a contact, a shaft upon which contact rocks, a shifter also rocking on said shaft and operatively connected with contact, a coiled spring around the shaft for



energizing shifter, and a controller also rocking on shaft for energizing coiled spring, shifter and controller each having side members and a bridge connecting them, the coiled spring lying within the side members of the shifter, and the latter lying within the side members of the controller.

TERMINAL FOR ELECTRIC CABLES. 881,777. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Company, Pittsburg, Pa.

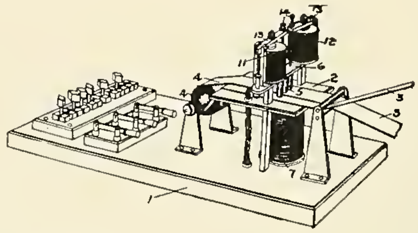
In a terminal for an electric cable the combination with a case or shell, of a plug for an outward leading wire, plug



being formed of insulating material molded on wire, and provided with an outwardly and downwardly flaring petticoat and provided with a groove for the reception of a line wire arranged adjacent to one end and above the plane of the petticoat, and having at its opposite end means for attachment to a support.

CHRONOGRAPH. 881,479. Ezra B. Merriam, Schenectady, N. Y., assignor to General Electric Company.

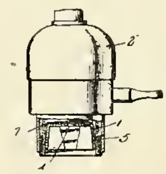
Means for recording the frequency of an alternating current, comprising an electromagnet connected to be energized



by said current, a table above the same, a bridge over table, a guide depending from bridge in line with electromagnet, and a loose weight in guide carrying a marking point connected to be actuated by current for producing alternating light and heavy marks corresponding with the cycles of alternating current of known frequency.

ELECTRICAL SOCKET-SEAL. 881,683. Llewellyn T. Hatfield, Sacramento, Cal.

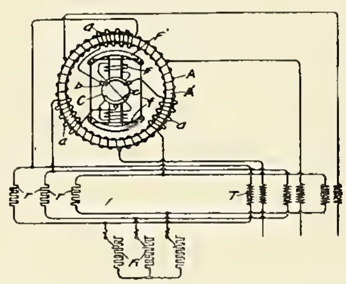
The combination with an electrical socket, of a sealing



device arranged in socket, permitting the insertion of a current consuming plug and preventing electrical connection with the socket contacts.

SELF-EXCITED ALTERNATOR. 881,647. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company.

In a self-exciting alternator, a main armature winding, an auxiliary winding, a field winding provided with a rectify-

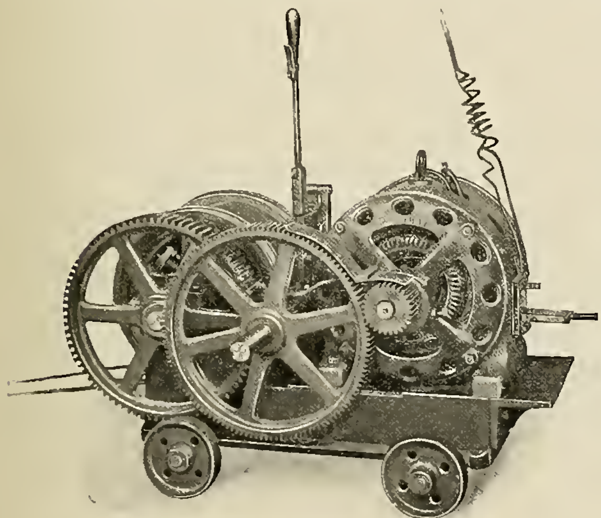


ing commutator, brushes bearing on commutator and connected to auxiliary winding, and a short-circuited winding carried by the field magnet in inductive relation to auxiliary winding.

INDUSTRIAL

SINGLE-PHASE MOTOR APPLICATIONS.

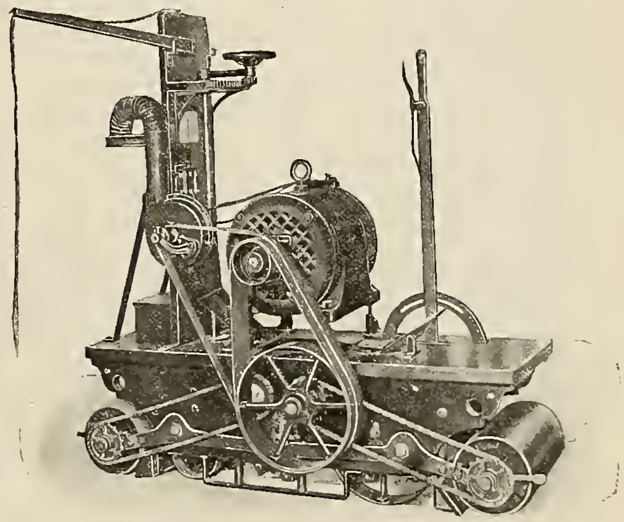
Examples of new applications of single-phase motors to industrial purposes are always of interest as showing its universality of possible use. The accompanying illustration shows a building contractors' hoist manufactured by the Patten Manufacturing Company, of Chattanooga, Tenn. The motor is a 7½-horsepower, single-phase, self-starting motor manufactured by the Century Electric Company, St. Louis. This outfit shown herewith has a capacity of hoisting 500 feet at a speed of 500 feet per minute. The machine is designed especially for hoisting brick, mortar, concrete, fireproofing, etc., by means of standard double-platform arrangements.



BUILDING CONTRACTORS' HOIST.

The platforms are started, stopped, and reversed by the operation of a single lever, which operates so simply and positively that a 15-year-old boy can operate it satisfactorily. The driving shaft of the hoist operates in one direction, so that standard, constant-speed motors can be used (thereby effecting considerable saving in the first cost of the motor), and also providing the means of operating a winch-head for hoisting lumber and other material with block and fall, and also provides for driving an extended shaft from which can be operated a concrete mixer, cut-off saw, etc., all operations being independent of each other. The feature that deserves particular attention is, this machine can be operated by single-phase motors with the same satisfaction when operating on one phase of a multiphase circuit as a single-phase circuit. This hoist is designed along lines radically different from any heretofore used, and represents the hoist development not often attained in the design of a portable builders' hoist. The weight of the outfit is such that it can be hauled in an ordinary brick wagon. This hoisting machine is manufactured for capacities from 500 to 1,000 pounds, and for speeds from 250 to 500 feet per minute. The manufacturers guarantee this hoist to save money on any brick or concrete building over one story in height; claimed to be able to raise 1,000 brick with mortar at a cost approximately of 2 cents for electric power.

After the building is constructed, the floors usually have to be smoothed, and for this purpose, the floor-surfacing machine, manufactured by the American Floor Surfacing Machine Company, of Toledo, Ohio, is rapidly coming into use. The illustration herewith shows one which is operated by a 5-horsepower, single-phase, self-starting motor manufactured by the Century Electric Company, St. Louis, Mo. This machine, the manufacturers claim, will do as much work as



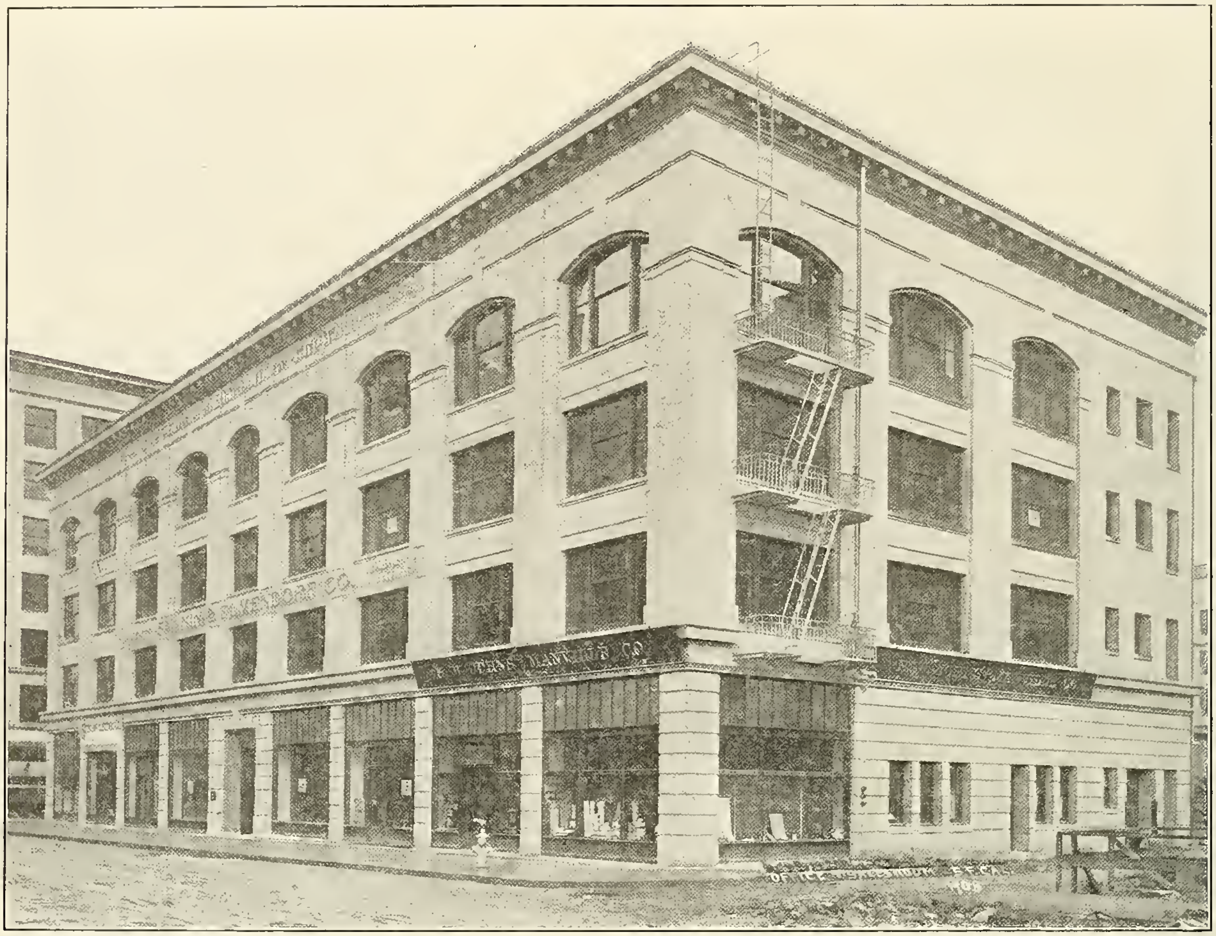
FLOOR SURFACING MACHINE.

20 men will do by hand, and besides, doing it much cheaper and better, and is rapidly creating a demand for surfaced floors, which will harmonize with the balance of the interior finish. This machine is adapted to the surfacing of every class of floors, from pine to the finest parquetry, from bowling alleys to the largest buildings in the country. The sandpaper drum is of such dimensions as to insure the best finish, which is impossible to accomplish by hand work. By a very slight change of the drums, the machine can be arranged to polish and wax floors, and thus be put to three distinct uses. The central station manager would do well to favor the purchase and use of such equipments in his city.

The Chase-Shawmut Company, of Newburyport, Mass., have placed upon the market the Shawmut Rail Bond Protector, a device designed to protect both the soldered and plug type of bond from being sheared off by wagon wheels, damaged by paving stones or ballast, injured by track crews and to discourage theft. This protector is made of heavy steel, securely fastened to rail by means of bolts, which hold fishplate in place, thus making application of the simplest nature. It is of such shape as to allow inspection of bond without removal of fishplates, and can be applied to either new or old rails at a minimum cost without impeding traffic.

H. W. JOHNS-MANVILLE COMPANY.

Recently, as was announced in these columns, the local branch of H. W. Johns-Manville Company moved to the commodious and convenient quarters at 159-165 New Montgomery Street, shown by the accompanying illustration. The



H. W. JOHNS-MANVILLE CO'S. SAN FRANCISCO OFFICE.

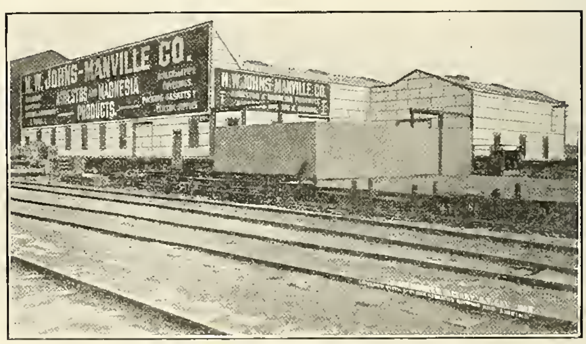
interior view of the office gives an idea of the manner in which the sales business is systematized, and the Oakland

INTERIOR OF OFFICE.

warehouse shows the shipping facilities of the firm. The new location gives every facility for handling all orders promptly and satisfactorily.

Mr. Chas. W. Scott has lately assumed the management of the San Francisco branch, and the general management of the San Francisco and Los Angeles branches of this company. His extensive experience as resident salesman for three years in the New York office, and his work as sales manager at Newark, N. J., has eminently fitted him to take charge of the company's interests on the Pacific Coast.

H. W. Johns-Manville Company has been closely identified with the development of the various uses of asbestos



SAN FRANCISCO WAREHOUSES.

and magnesia products. These possess protective and insulating qualities that are applicable to many industrial needs. Asbestos is mined from narrow veins as a mineral resembling

serpentine. It yields strong fibres that can be woven or spun in various forms that are not only fire and acid proof, but also non-conducting. Magnesia as prepared from magnesium carbonate will set when mixed with water to form infusible shapes that are likewise insulating.

These materials are made into sectional pipe coverings and conduits. They make various packings for steam, air, oil, and gas, and are also used in papers, sheets, blocks and cements. One important application is for roofing and building, incidentally being used on the warehouse roof shown in the accompanying view.

The electrical uses are important, including "Noark" protective fuse devices, Vulcabeston and "Phoenix" insulation and overhead line material. The electrical end of the business has become so important as to require the services of a large corps of salesmen. S. P. Russell, Jr., has lately assumed charge of the local electrical department.

AIDS TO THE SOLUTION OF PRACTICAL ILLUMINATING PROBLEMS.

The science of illuminating engineering is as yet in its infancy, and data of value in the laying out of lighting installations is not plentiful. The activity of the General Electric Company in the advancement of the art of illumination is evidenced by its systematic dissemination of information on this subject. Two bulletins, recently compiled by the Harrison, New Jersey, Works of the Company, illustrate the thoroughness with which such subjects are now being treated. These bulletins are valuable primarily to the practical man engaged in planning lighting installations and are also of interest to every central-station organization as a whole.

A perusal of these bulletins, Nos. 4561 and 4506, on Gem High-Efficiency Incandescent Units and Tantalum Incandescent Lamps, respectively, will convince the reader of their value as aids to the solution of practical illuminating problems. The illumination tables contained in these bulletins are invaluable in such work, and contain information hitherto not available. This data lends itself readily to the laying out of lighting installations, and will be appreciated by architects, contractors, solicitors, and others daily confronted with the solving of illuminating problems.

In Bulletin No. 4566, the tantalum lamp, with its high efficiency and long life, is specially recommended to central stations as a desirable factor in the reducing of peak load conditions, inasmuch as the use of the 40 or 80-watt tantalum lamps gives the customer twenty-five per cent more light than the standard 16 or 32-candlepower lamps, and with an expenditure of twenty per cent less energy on the part of the central station. Thus it is seen that the general satisfaction which attends the use of the tantalum lamp is shared alike by both buyer and seller of current. Stress is laid on the brilliant and attractive quality of light emitted by the tantalum lamps, qualities which make it most desirable for hotels, theaters, cafes, stores and all public buildings.

The use of the table showing the actual amount saved in dollars and cents by the use of these lamps, should prove of great value to lighting solicitors as a convincing argument in favor of the more brilliant and efficient tantalum lamps. This table shows that the tantalum lamp, at the average lighting rates now in force, will save more than twice the initial cost during its average life of 750 hours.

Several pages are devoted to the elucidation of a practical method for the solution of illuminating problem. The illumination table intended for use in connection with this method is comprehensive for the 80-watt lamps with three types of holophane reflectors, and by interpolation can also be used for the 40-watt and 50-watt tantalum units. Several curves giving the candlepower distribution with different types of holophane reflectors are also shown.

Bulletin No. 4561 contains valuable information in regard to "Gem" high-efficiency incandescent units. These lighting units are composed of the "Gem" lamps with varying types of holophane reflectors, and are made in 100, 125, 187 and 250 watt sizes. Candlepower values of these lamps are not given, as it is obvious that these values will vary according to the type of reflector used.

The method of solving illuminating problems, which was referred to in Bulletin No. 4566, is here treated more fully. The subject of illumination in general is taken up and treated briefly. This is followed by a specific treatment of the subject with reference to "Gem" high-efficiency units. Assuming the degree of illumination desired, a problem is worked out, reference being made to the illumination tables for the solution.

Two photographs are shown of the interior of a dry goods store before and after the installation of "Gem" units. The original installation consisted of six light electroliers with ordinary 10-candlepower incandescent lamps, placed seven and three-fourths feet from the floor. The "Gem" installation consisted of 125-watt high-candlepower units, with holophane reflectors. These units were installed on the ceiling fourteen feet above the floor.

DOSSERT & COMPANY.

Among the labor-saving devices in the field of electrical construction, none is likely to attract more attention than that of Dossert & Company, Inc., manufacturers of the well-known "Dossert Joints" and solderless connectors and terminals for electric wires and cables. Dossert & Company is one of the younger set, and although its advent in the field of manufacturing electrical equipment is of comparatively recent date, the remarkable increase of the company's business during the past three years, in the face of apparently insuperable obstacles, has attracted not a little attention in the electrical world.

The history of the triumph of the Dossert principle is well known to those who have followed the many phases of development in electrical work, but a word of recapitulation may not be out of place. The Dossert Joint is a mechanical device designed to splice wires securely and to make a perfect electrical connection without the use of solder. This, of course, was a proposition to revolutionize the method of splicing wires, and when Dossert & Company asked for the approval of the National Board of Fire Underwriters, in 1905, the new joint was examined with great interest. It was then decided, however, as the practice in vogue afforded nothing on which to base judgments as to how the Dossert device would meet the varied requirements and contingencies of usage, field experience was necessary. Provisional approval was accordingly granted, subject to the assent of local inspectors. After field experience and laboratory tests covering a period of over two years, the National Board of Fire Underwriters, at their meeting in New York in March, 1907, unanimously adopted an amendment to the rules allowing the use of an approved mechanical joint without solder. Two months later, the Dossert Joints were placed on the list of approved fittings, and it is the only approved mechanical joint.

In the field of electric railways and the electrification of steam railroads, the Dossert Joints have indeed met the proverbial "long-felt want." The list of users is a long one, headed by such names as the Pennsylvania, New York Central, Delaware & Hudson, Interborough-Metropolitan, Chicago City Railways, Metropolitan West Side Elevated, Philadelphia Rapid Transit, and many others. Dossert & Company's factory and office is at 242-244 Forty-first Street, New York City. F. A. Lawson & Co. are Pacific Coast agents, at 209 Monadnock Building. San Francisco, California.

NEWS NOTES

TELEPHONES.

Washougal, Wash.—Home Telephone Company, $1,000. C. M. Keep, Morris Webber and A. J. Hendrickson.

Leavenworth, Wash.—The Clockum Telephone Co. was given a franchise to erect and operate a telephone line along the county roads.

Aberdeen, Wash.—J. A. Phillips and others were granted a franchise for a telephone on the Johns River road, between Western and Markham.

Seattle, Wash.—Application has been made by John L. North et al., for a telephone franchise. Hearing will be had on same April 14th.

Newport, Wash.—R. D. Anderson, who was recently granted a telephone franchise by the Newport authorities, has begun the construction of the new exchange and system.

Rockford, Wash.—Workmen have been engaged on the Mount Hope and Rockford telephone line and connections, stringing an extra wire and making the line a metallic circuit.

Colville, Wash.—E. H. Humphrey has been granted a franchise to build a telephone line from Blue Creek to Eddy, along the public highway, with the privilege to extend for fifty years.

Sunnyside, Wash.—Sunnyside Telephone Co., of Yakima, $15,000. J. J. Brown, Emery Thompson, George E. Rodman, F. J. Taylor, U. G. Merrill and S. T. Woodin are the new incorporators.

Silverton, Ore.—P. L. Brown is extending his telephone lines farther into the country daily, and is connected with about all the towns in Marion and Clackamas counties, and a farm house without a phone is rarer than those with them.

Kent, Wash.—The Pacific Sunset Telephone & Telegraph Company is making arrangements to improve Kent long-distance service, by giving Kent an additional Tacoma-Seattle wire, and stringing an additional wire direct from Kent to Seattle.

Vancouver, Wash.—Moore & Hardin, local contractors, have secured the contract for putting in the concrete work for the Home Telephone Company. The Minnehaha foundry is turning out the manholes for the same company, and has already delivered a large number.

Colfax, Wash.—The farmers of the wheat belt lying south of Colfax, between here and the Snake River, have organized a company for an extensive system of rural telephone lines. The new company is known as the Penawawa Telephone Company, Ltd., and the line starts from the long-distance office at Colfax.

Bellingham, Wash.—Five hundred feet of the Magnolia Street underground system of the Sunset Telephone Company has been destroyed by electrolysis, caused by a current from the Whatcom County Railway & Light Company's trolley system. A current from the rails has penetrated the ground several yards distant and for a depth of about five feet, reaching the lead pipe casing of the telephone cables and making them useless. The telephone company has laid temporary wires for the benefit of subscribers affected by the paralysis. The damage to the company in cable alone is $750.

Edmonds, Wash.—Articles of incorporation of the Edmonds Independent Telephone Company were filed last week. The capital stock is $2,500, and the officers are: President, A. M. Yost; vice-president, James Mowatt; secretary, Zophar Howell; treasurer, T. A. A. Siegfried. Other stockholders are: J. N. Otto, O. W. Schmidt, C. D. Everton, Charles Preston and C. D. Johnson.

Vancouver, B. C.—The Dominion government, in response to a numerously-signed petition, has decided to establish a system of telegraph communication between Prince Rupert on the mainland and the Queen Charlotte Islands. It will also build a telegraph or telephone line to connect the islands of the group, and will also install a system of gas buoys at various points on the islands, including Jedway, the new mining camp.

WATERWORKS.

Eureka, Cal.—G. M. Scott claims 600 inches of water flowing in Oil Mill Creek, in T. 8 N., R. 1 W., for the purpose of supplying water to residents of Trinidad, and for general electric power.

Los Angeles, Cal.—The Brawley Town & Improvement Company has plans completed for an expansion of the domestic water service to cover many new sections of the townsite. Within the ensuing month from 15,000 to 20,000 feet of new water mains will be laid.

Ogden, Utah.—The Wheelwright Construction Company, of Ogden, has closed a contract with the American Falls Realty & Waterworks Company, of Pocatello, for the construction of a waterworks system at American Falls, which will cost about $15,000.

San Francisco, Cal.—The Sunnyside Improvement Club has filed a complaint against the Spring Valley Water Company with the Supervisors. It is alleged that at times householders are without water, and in the event of a fire the engines would be out of commission.

Lodi, Cal.—At a meeting of the City Trustees this week, several sites for the proposed municipal water and light plant were considered, and the Osborne tract in South Lodi was selected as the best adapted for the purpose. It will be acquired for the purpose by the usual method of procedure. The plans of a water and light plant to established at Rawhide, Nev., were exhibited at the meeting, by J. S. Williard, of Oakland. This system will cost $50,000, not including the pipe and freight.

ELECTRIC RAILWAYS.

Grants Pass, Ore.—The Council is now considering the application of W. H. Patillo for an electric street railway franchise.

Ashland, Ore.—The Rogue River Electric Rapid Transit Company filed articles of incorporation at Grants Pass. The incorporators are Captain Evans, F. E. Merrick, J. E. Watt, Dr. Page, A. S. Bilton and S. A. Nye.

Pasadena, Cal.—Mayor Farley has been informed by officials of the Pacific Electric System that H. E. Huntington has directed that work of double-tracking the lines in Pasadena proceed. This work was halted last fall by financial stress.

San Diego, Cal.—The bid of the San Diego Electric Railway Co. for a street railway franchise on Hawk and Lewis streets which called for $125, was accepted by the City Council at a recent meeting. It is for an extension of the Third Street line.

Klamath Falls, Ore.—The Inland Electric Company has appeared before the Klamath Falls Council asking for a franchise from the eastern limits of the city to the end of the line of the Klamath Falls Land & Transportation Company. It is the intention of the company to construct and operate a line between this city and Merrill. Some rights of way have been secured.

Walla Walla, Wash.—Arrangements have been almost completed for the construction of a street car line from the business part of the city to the Fair Grounds. The track will be an extension of the city line, and about three-quarters of a mile must be built. In order to secure it, stockholders of the Fair Association have agreed to take care of $10,000 bonds of the traction company.

Berkeley, Cal.—A number of surveyors working under the direction of Albert van der Naillen have been engaged in mapping out the route of the proposed electric line which will be operated, by Sam L. Naphtaly and others, from the Claremont Hotel in Berkeley over the tunnel road to Walnut Creek and adjoining towns. A route for the proposed line was surveyed last fall, but the three-per-cent grade was found to be too steep for the style of motor that will draw the cars over the tunnel road. The engineers are seeking a two-per-cent grade.

Olympia, Wash.—The Pacific Power & Railway Company has served upon the State Land Commissioner notice that it will petition the Superior Court of Cowlitz County to condemn and appropriate the waters of Toutle River. It is intended to use the power furnished by the river to generate electricity to operate a railway from Vancouver via Kalama and Kelso to Castle Rock, and branch lines from Castle Rock to the head of Green River and to Spirit Lake. It has been reported that this company is affiliated with the organization of capitalists who are planning the construction of an interurban railway between Seattle and Portland.

Palouse, Wash.—Julius Muhrbeck, superintendent of construction on the Spokane & Inland, has been in Palouse during the week, looking over the ground and arranging to begin laying steel on the Moscow extension about April 1. Mr. Muhrbeck states that from 75 to 100 men will be required on the work. The grading between here and Moscow was practically completed last fall, with the exception of one large dirt cut about half way between the two towns. It is estimated that trains will be running into Moscow by August 1. A local rumor is that the road will be built on to Lewiston without any delay.

Granger, Wash.—The Inter Valley Electric Railway Company held a business meeting in North Yakima last week, and elected the following officers: H. H. Lombard, president, North Yakima; J. H. Thomas, vice-president, Yakima City; Geo. P. Eaton, secretary, Granger; R. G. Page, treasurer, Sunnyside. Walter N. Granger, owing to a press of other business, resigned as trustee, and E. F. Blaine, of Seattle, was elected to fill the vacancy. The company has engaged F. N. Noble as head of the engineering department. He has already made the survey between Granger and Parker, and the right of way committees will go into the field Monday. There seems to be at present every indication that the company will be running cars and relieving this season the annual congestion of freight traffic.

Portland, Ore.—Between this date and April 1 the Mount Hood Railway Company will resume construction work with a larger force of men than it was employing prior to the financial stringency that stopped work last October. The Mason Construction Company, which retains the contract for twenty-five miles of the line between Portland and Bull Run, will put on about 800 men and the railroad will be pushed through to the east limits of the city. Machinery for the first installation of 15,000 horsepower is now being received every week for the Mount Hood Company's big electric power plant at Bull Run postoffice. The water from the Sandy River is to be utilized there to generate power. A vat reservoir is being erected on the plateau near Bull Run postoffice, where the company has purchased many hundreds of acres of land.

San Francisco, Cal.—The residents of Pacific Avenue have been promised a cable system by the United Railroads and the officials of the company have announced that the line would be in operation between Polk and Broderick streets within six weeks. A letter was received by Oscar Sutro, one of the opponents of the proposed trolley system on that street, from Patrick Calhoun, president of the United Railroads, in which Mr. Calhoun promised to install a cable line if a majority of the residents on Pacific Avenue wanted it. "We now have in our possession," said Mr. Sutro, "a petition signed by seventy per cent of the property owners on Pacific Avenue, between Polk and Broderick streets, asking for a cable system." Cars will have to stop at Polk Street, as they are not of the same gauge as the trolley cars operated on parallel streets running to the ferry landing. Transfers will be issued from the Polk Street terminal to the other line operated by the company.

ILLUMINATION.

San Francisco, Cal.—Forty arc lights will be reinstalled in the Park Panhandle and along the main drive leading to Strawberry Hill, as directed by the Supervisors' artificial lights committee.

Riverside, Cal.—An application for a gas franchise has been made to the Board of Supervisors by the Banning Gas & Lighting Company, to operate in the streets of Banning and Beaumont, Riverside County.

Oroville, Cal.—A few weeks ago the Valley Counties Power Company sold to the Bay Counties Power Company all its property of every kind in Butte County. Last week two more power company transfers were made: The Bay Counties Power Company transferred to the California Gas & Electric Corporation the property obtained from the Valley Counties Power Company. The California Gas & Electric Corporation transfers to the Pacific Gas & Electric Company all the lots, pieces or parcels of land in Butte County named in a deed from the Valley Counties Power Company to the Bay Counties Power Company.

OIL.

Ellensburg, Wash.—Miller Bros., of this city, have closed options on 600 to 700 acres of land in Badger Pocket, where they will shortly begin drilling for oil, there being excellent indications on the farm of Louis Larsen. They contemplate going down 2,000 feet, or even deeper, and have ordered special machinery for deep-hole work.

Los Angeles, Cal.—It is reported that the Sunset Railroad is to be extended into the Midway field. Southern Pacific surveyors are at work along the prospective right of way. If the report is correct, the Midway operators will come into their own. That district is suffering from lack of transportation facilities, and the price of oil is ten cents a barrel less than at other fields of the San Joaquin Valley.

Santa Maria, Cal.—The Palmer Oil Company has entered into a contract for a pipe line having a daily capacity of 12,000 barrels, to be built from its new field to Santa Maria. The Associated Company, which has purchased 2,000,000 barrels of Palmer oil, will do the construction work. The line will be finished within seventy-five days, by which time the contracting company will have about 35,000 barrels of petroleum ready for delivery. The Palmer land is about three and one-half miles from the rich Santa Maria producing field.

Los Angeles, Cal.—At an approximate cost of $700,000, the American Petroleum Company has taken over the ranch of William Niles, at Sherman, and has three rigs boring for oil. This ranch is surrounded by proved oil wells, and is considered an important deal. The American Petroleum Company was quietly organized several weeks ago, with a capital said to be nearly $10,000,000. The American Petroleum Company already controls and is interested in about 11,000 acres of oil-bearing land in Monterey County. Development work is being pushed.

Los Angeles, Cal.—At 2,755 feet down, the Newport Bay Oil Company has its first well at Newport Beach on the pump, after months of trouble and delay. It is but four inches and a half in circumference at the bottom, and the hole is not perfectly straight, hence only a two-inch pump can be used. The present output is between 75 and 150 barrels a day. Water, encountered at 2,160 feet, gives much trouble, and the yield of oil is from ten per cent to seventy-five per cent to proportion of water, varying this much from day to day. It is the usual California asphalt base, 25 to 30 gravity, or possibly higher, declared by a local refinery to be among the very best produced for making light distillates, $1.05 a barrel being offered at the well. Three hundred to four hundred barrels have been taken out and used in further drilling.

Bellingham, Wash.—The Bellingham Bay & British Columbia Railway this year will improve about a mile of its tracks in this city, between the Sehome Dock and York Street. The tracks have become shapeless in places. The work will be started soon. The company also contemplates laying heavier steel on the grade beyond Whatcom Creek for about two miles. Sixty-pound rails will be laid. Just when this work will begin Supt. H. B. Paige is unable to say.

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., APRIL 4, 1908 No. 14

BERLIN-CHARLOTTENBURG FIRE DEPARTMENT.

Charlottenburg is the largest suburb of Berlin, and noted for its splendid streets, squares and municipal institutions. There are three fire stations, one of which was equipped with automobiles two years ago. Ten weeks ago the third depot was furnished exclusively with power-driven vehicles, and there are now in Greater Berlin two stations where horses are entirely eliminated. The wagons illustrated herewith are all electrically-driven, and consist of a gas engine, ladder and steam engine. The former (Fig 1) offers accommodation for twelve men, and carries all saving appliances as it proceeds the fire train. Of special interest is the frame, which does not contain channel iron, as usual, but cast-iron tubes which serve also as water carriers, for no less than 450 liters of water is carried within the two longitudinal and transverse pipes. This water is let out by the pressure of carbonic anyhydride. This is used for the first attack, when the big fire engine has not yet arrived. The car is propelled by electric motors of 15-25 horsepower. They are mounted within the front wheels, assuring a direct drive. Current is taken from a battery below the chassis containing 80 cells. The power is sufficient for 30 kilometers, and run at a speed of 20 to 30 kilometers per hour. The batteries are arranged for 29-ampere charging current and 130 amperes for discharge. The switchboard allows five different positions, or five speeds ahead; also one for stopping and one reverse. All wheels are fitted with solid rubber with anti-skidding tires. The wheels are of cast steel.

ELECTRIC FIRE FIGHTING APPARATUS.

As regards the manner of propelling the ladder and steam fire engine, it is similar to the gas engine, only the water pipes are replaced by channel beams acting as chassis-girders. On the ladder vehicle the battery is mounted upon the car in two boxes, used as seats. Here also a third electromotor is to be fed, which has to lift and slide out the heavy ladder, and rests within the turn-table. The ladder consists of steel pipes that telescope.

The steam engine is an electromobile. Thus steam is saved for the pumps, and the readiness to act immediately is greatly favored. The batteries are mounted underneath the first bench, one-third and two-thirds beneath the second cross-seat.

In the barn there is a post beside each vehicle, with cable-joint for charging. Energy is taken from the 3,000-volt rotary current produced by the municipal plan. A special transformer sub-station is built which steps down the current to 120-volt. In the motors continuous current of 55 amperes and 220 volts is used.

MEASURING GAS LIGHT AND HEAT.*

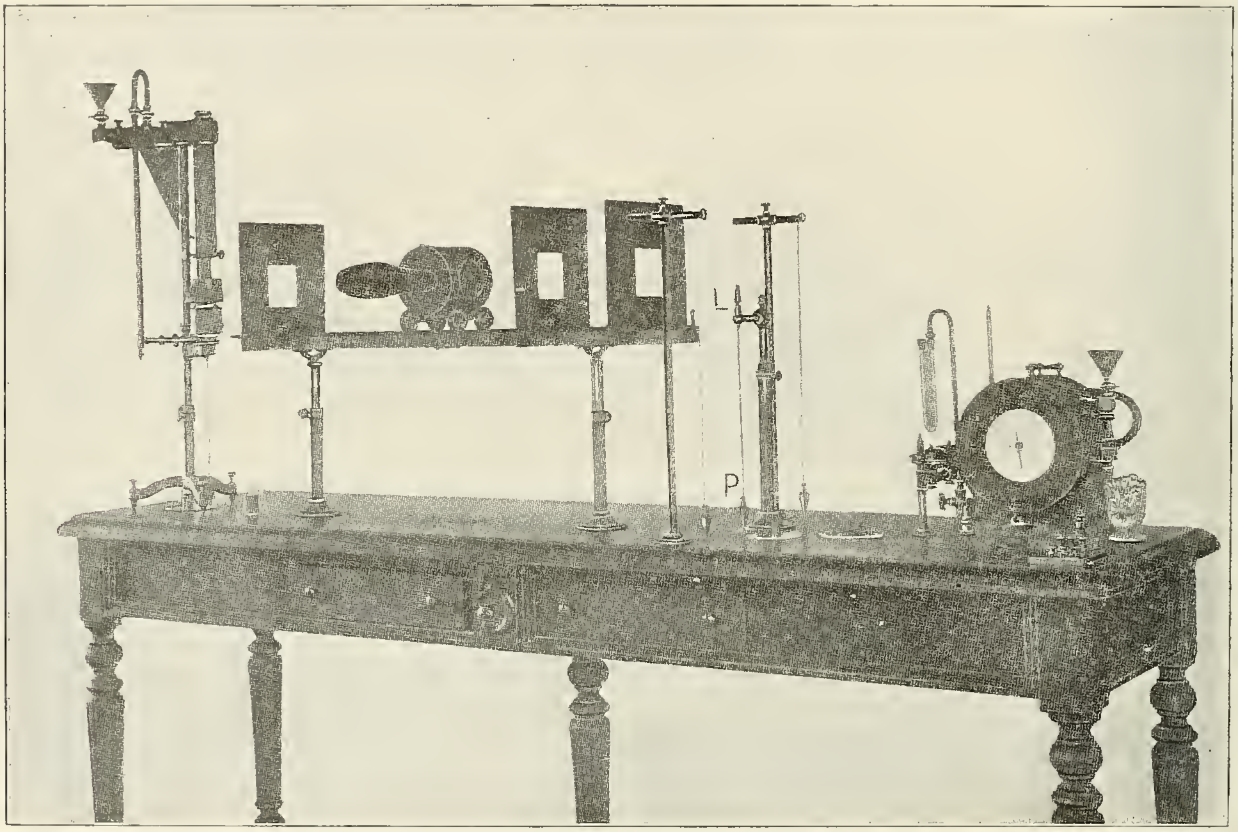
By J. B. Klumpp, Gas Expert of the National Civic Federation.

Photometry is that branch of scientific measurement which deals with the comparison of the illuminating values of different sources of light, and in the sense in which it is generally used by the gas industry, it treats of the illuminating value of a gas flame.

The illuminating value of a gas flame depends greatly upon the method in which the gas is burned, and therefore, to make relative comparisons it is absolutely necessary that the gas should be burned under certain specifications. These specifications are generally uniform throughout England and the United States, although some slight modifications have occurred from time to time. For instance, the illuminating value of the gas is always expressed in figures that give the candle power of the gas flame when burning at the rate of five cubic feet per hour; and the measurement of the gas so burning should be at a certain prescribed atmospheric pressure and temperature, and if not burning under these specific conditions, its volume should be corrected so as to give a volume equivalent to that under the prescribed pressure and temperature.

In the United States this standard of atmospheric pressure is 30 inches barometer and standard of temperature 60 degrees Fahrenheit. If these standard conditions did not prevail, it would be impossible to compare the candle power as the tendency of the gas to expand on decreasing barometer and increasing temperatures is very great, and in all perfect gases, follows a definite law that enables this correction to be easily made.

In addition to these conditions, it has been found necessary to describe the type of burner through which the gas shall burn, as the gas flame should be stable, uniform in shape and comparatively quiet. If the five feet of gas should be forced through a very small burner and appear to blow, so to speak, the true illuminating value is not obtained, and the gas will give considerably less than its normal light. On this account it is customary to measure the gas as burned through standard burners or tips.



GENERAL VIEW OF PHOTOMETER READY FOR USE.

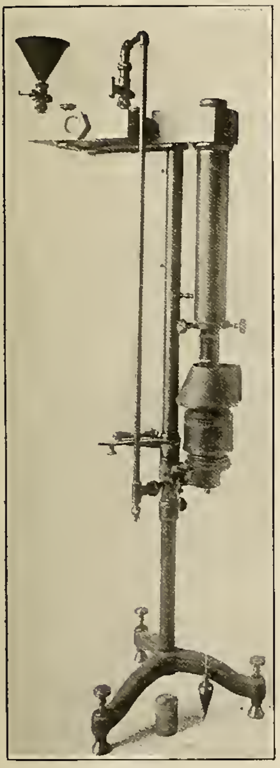
In the case of coal gas, an argand burner of the Sugg D type (named after the Englishman who invented it) has been generally adopted. This burner has been perfected recently so that it will burn various kinds of coal gas and regulate the mixture of gas and air more definitely. This improved type of standard burner is illustrated in the Metropolitan No. 2, invented by Mr. Carpenter, of London, and is being used throughout England and some cities in the United States.

The higher value illuminating gases, such as carburetted water gas and the richer oil gases, have been found to give more satisfactory results in burning through what is called the "open flame E. H. (excavated head) lava tip" of the No. 6 or No. 8 size. This tip is the small lava slotted tip that is used in commercial practice.

*Reproduced by courtesy of "Public Service."

Optical Comparison Necessary.

Now, to determine the value of a gas flame, the measurement of the light can only be obtained through some optical comparison, and to do this it is necessary that a standard or a light having a known illuminating value be used. The practice for many years has been to assume the candle as this known illuminating value, and, in England, the British standard candle was the first unit adopted, and even to-day is considered the unit of measurement, although the candle itself is not always the operating standard. An ordinary candle would not do for such scientific work, so the original English specifications designated the illuminating value of one candle to be the light given out by a sperm candle, weighing six to a pound, and burning 120 grains per hour. These specifications, however, have since been modified, and the number of strands of the wick and the quality of the sperm and the exact dimensions of the candle itself have been further specified.



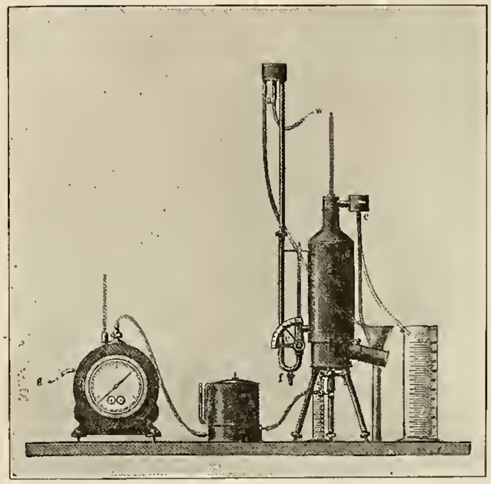
THE PENTANE LAMP.

In burning these candles, they must be delicately mounted in a balance, so that the rate of consumption shall be known within prescribed limits. As the progress of the art developed, it was found that for rapid and accurate work it would be more convenient to adopt some standard that could be more easily operated and give generally more uniform results, and to this end Mr. A. Vernon Harcourt, an eminent English authority, invented his 10-candle power pentane lamp; and the original lamp, once having its value determined by candles, is easily duplicated.

Since 1895 this 10-candle power pentane lamp has been generally used throughout England and many cities in the United States as a standard by which illuminating value of gas is determined. This lamp, as shown by the cut, is a very scientific instrument, and constructed carefully to prescribed specifications; it burns pentane, a refined distillate of petroleum, that is chemically prepared and constant, hence the light-giving value of the lamp is absolutely reproducible. Several secondary standards, such as the Edgerton and the Methven standards have been substituted by various companies for convenient use, but their value must first be determined either by comparing them with standard candles or by comparing them with a standardized pentane lamp. The Hefner lamp—a small 1-candle power or 2-candle power open flame lamp burning amyl-acetate—has been used as a standard by some countries and by the electrical industry in this country; but its unit is somewhat smaller than the British candle.

Principles of the Photometer.

Having a standard and the gas flame itself, it is necessary to have an instrument whereby these two sources of light may be accurately compared. Such an instrument is called a photometer. In this country the type of photometer generally used in gas works practice is the "bar" photometer, so named because a graduated bar is supported between the two sources of light and a carriage containing an illuminated disc is moved back and forth between these sources of light until it appears equally illuminated on both sides. This form of photometer is shown in the accompanying cut. It shows the method of comparing the gas flame with the 10-candle power pentane lamp standard. The standard lamp is shown on the left of the bar. The flame of this lamp and the flame of the gas are in direct horizontal line with the center of the disc of the carriage and the holes in the screens on the graduated bar. The gas flame should be shown burning from the tip at "L."



JUNKER GAS CALORIMETER.

The well-known optical principle of this comparison is that, first, the intensity of illumination of a lighted surface varies directly with the intensity of the light-source illuminating that surface. Second, the quality of light falling on this given surface varies inversely as the square of the distance of that from the light-source. As above stated, this might seem a rather complicated law, but it may be very simply expressed by saying if any one object is twice as far from a source of light as any other object, it will receive one-fourth of the amount of light per equal unit of surface. Applying this law to a disc supported on a graduated bar between a known source of light (as a standard) and the gas flame to be measured, it is very easy to determine the value of one light in terms of another.

The illuminated disc, known in this case as the Leeson disc, by which this point of comparison is measured, is of rather peculiar construction. It is formed generally of three pieces of white paper; the middle piece is of opaque, thick paper, uniform in quality, and finished on both sides, and it has a star stamped from its center. On each side of this is placed a thin sheet of white, rice tissue paper. These three pieces are cut round and placed between two discs of white French plate glass, so that their surfaces are flattened out.

The star opening cut in the thicker paper being more translucent than the surrounding field, when held up to the light, appears to be brighter. This disc, being placed on the bar, is moved first towards one and then towards the other light, until the disc, both sides of which are seen by the observer through reflecting mirrors, appears equally illuminated on the entire area of both sides, and the point at which this takes place on the bar determines the distance of equal illumination of both sources of light. The scale on the bar is so graduated or marked that the readings designate directly the exact ratio of value of the light sources.

Great Care Necessary.

In the cut of photometer herewith, on the right will be noticed a circular gas meter. This is a small wet meter with a revolving drum submerged about two-thirds of its distance in water. The gas entering this meter is measured by the compartments as they revolve above the water, and it is so designed that one revolution of the drum will pass one-twelfth of a cubic foot of gas. Therefore the meter drum, when passing gas at the rate of five cubic feet per hour will make exactly one revolution in one minute. This being carefully checked with a stop watch, the rate of consumption of the gas may be accurately determined and maintained.

A double dry governor is shown on the left of the meter. This regulates the pressure of gas to within a tenth of one inch of water pressure, as recorded on the "U" gauge above it. There is a micrometer cock between the governor and the gas flame that will enable the observer to regulate the size of the flame to a nicety and always allow of rapid adjustment to produce a uniform rate of flow of the gas being tested.

The positions of the standard light and the gas flame are determined by plumb-bobs that are suspended over centering lines engraved on the surface of the table. The graduated bar is supported between the two light sources; the middle of the scale has a plumb-bob that enables it to be also adjusted over a center line in the table. A very close adjustment of this scale may be made by means of a micrometer screw. Screens are placed on the photometer bar to prevent any extraneous light from entering upon the disc and also to protect the eyes of the observer. The disc in the box is made reversible so that each side may be exposed alternately to the different sources of light, which will eliminate any errors due to inequalities of the paper.

The photometer described as above should be erected in a room that is practically light-tight, with all outside light excluded, and the wall should be painted a dead black or a very dark green color. There should be no light objects in the room that may act as reflectors. The floor and the table should be comparatively firm and free from vibration. The room should be well ventilated and without drafts and the temperature as near 70 degrees as the climatic conditions will permit. It is convenient always to have window whereby outside light may be admitted when desired, but this should be protected by dark shutters during operation. After entering the darkened room, ample time should be given by the observers to accommodate themselves to the new light conditions before attempting to make any observations of candlepower.

The operation of reading photometrical apparatus does not necessitate any technical education or training. Observations of candlepower may be made by any intelligent person who will take pains and be careful in his work. However, it is absolutely necessary to have good instruments, carefully erected and calibrated—perfect standards—and a systematic method of observing and checking all conditions and readings.

Values of Different Gases.

The candlepower of gases varies very greatly, according to the kind of gas and the method of its manufacture.

All gas is considered by the layman to be just gas, but the materials from which it is manufactured and the methods of manufacture vary so greatly that a gas should be generally described by its name, its candlepower, its analysis, or its heating value. Coal gas, for instance, is obtained from direct distillation of bituminous coal. The quality and kind of coal used determine generally the quality of the gas obtained; but this quality may be more or less improved or impaired according to the methods adopted in its manufacture. For instance, coal gas generally as understood in this country will vary from 12 to 16 candlepower, it will have a heating value from 550 to 620 British thermal units to the cubic foot, and will show analyses that are more or less similar in their general characteristics, but will vary according to the amount of illuminants and the methods of manufacture.

Carburetted water gas, the other illuminating gas in general use in this country, varies greatly in its character according to the quantity of oil used in its enrichment, and the method of treatment during manufacture. As it is generally known in every-day practice, it varies from 15 to 25 candlepower and from 550 to 650 British thermal units per cubic foot. Carburetted water gas can always be recognized by experienced gas men by its analyses, but these analyses vary, as stated before, with the quantity of oil used in its manufacture and also with the method of its treatment.

There are many other types of gases, such as natural gas, producer gas, and gases obtained as by-products from different manufactures; but these gases, with the exception of natural gas, are not suitable for urban distribution. They are complex in quality, generally containing more or less nitrogen, due to the injection of air during their process of generation, and are comparatively low in candlepower and heating value, but may be used locally in many cases as a fuel or for gas engine power purposes. But their use in general distribution has been found prohibitive..

Natural gas, of course, is obtained only in certain localities in the United States, and on account of its enormous volume of production and its practically uniform composition and high heating value it has been found suitable for general distribution. However, its candlepower is very low, generally about 4 candlepower, and in some few localities reaching, possibly, 10 candles. Its average calorific value is about 1,000 British thermal units per cubic foot. The reason for its comparatively low selling price is due, of course, to the fact that no works or materials are required for its production nor any manufacturing expense.

Gas Calorimetry.

Calorimetry, generally speaking, is a method of measuring heat, and, specifically speaking, it is a measurement of heat produced by the combustion of a certain substance or matter, such combustion taking place under prescribed conditions to warrant relative comparisons. As applied to gas in this country, it means the measurement of heat produced in burning one cubic foot of gas at a certain prescribed temperature and pressure. The temperature considered normal, or standard, in this country is 60 degrees Fahrenheit, while the normal barometric pressure is 30 inches of mercury. The volume of the gas burned in measuring its calorific value is corrected to these normal pressures and

temperatures in a way similar to that applied in the correction of the gas for photometrical purposes.

The instrument used to determine the heating value of any substance is called a calorimeter, and that used for any particular substance is generally designated by prefixing the name of the substance to be measured, hence the gas calorimeter or the coal calorimeter. The gas calorimeter depends for its action upon a most simple and controllable method—that of heating water. A certain quantity of water is heated and its rise in temperature is observed, and the quantity of gas burned being known, the heating value of the gas per cubic foot is easily determined. The heat unit as used in this country and England is the British thermal unit, generally expressed as a "B. T. U.," and is the amount of heat which is necessary to raise one pound of water one degree Fahrenheit at the temperature of 39 degrees Fahrenheit. It is nearly the same for each degree above that within the normal temperature of observation.

This heat unit is used to describe the amount of heat obtained in the combustion of various substances, including gas, and the amount of heat given off in the combustion of one cubic foot of gas is thus quoted as so many British thermal units, or B. T. U.'s. A gas of 575 B. T. U. has a heating value that will produce during its combustion enough heat to raise 575 pounds of water one degree Fahrenheit, or 57.5 pounds of water 10 degrees Fahrenheit.

The calorimeter, to give accurately relative comparisons, must be a practically perfect water heater; in other words, it must have an efficiency as near 100 per cent as it is possible to obtain. The water entering the calorimeter should be at the temperature of the room, or atmosphere, where the apparatus is erected. The gas being measured should and will be found to be practically at the same temperature as the atmosphere, owing to the fact that the meter and the contained water are practically at this temperature. The products of combustion leaving the calorimeter should be at this same temperature, or as close as it is possible to get them. Then, under these conditions, the quantity of water entering the instrument being accurately known and its increase in temperature or the difference between the outlet temperature of the water and the inlet temperature of the water being observed, these facts determine accurately the amount of heat absorbed by the water or the amount of heat given out by the combustion of the known quantity of gas.

The Apparatus Employed.

A cut of the calorimeter is herewith shown. The instrument in question is of the "Junker" type, more or less universally used throughout the world. It will be noticed that it has a wet meter similar to that in use with the photometer. From the meter the gas passes through a wet balanced governor regulating delicately the supply of gas to the burner.

The gas burner is placed under and inside of the water heater.

The inlet water passes over a small weir in an elevated cup provided with an overflow, thus maintaining a uniform head in the heater. The water is then led through the instrument through a series of pipes so arranged as to absorb all of the heat produced by the burning gas. The overflowing water is collected and measured.

The general practice abroad is to measure the water in a graduated vessel and this same practice is probably more universally applied in this country, but it will be found convenient to substitute a weighing scale, reading to hundredths of a pound and weigh the water, which result given in pounds, determines at once the heating value in thermal units which are expressed in terms of pound-degrees.

The heating value of a gas as generally expressed in this country is the gross of actual heating value, which is the heating value as determined by the calorimeter. The so-called "net" heating value is sometimes referred to, but being difficult to obtain accurately from all present designed calorimeters, it is not in general vogue. It means the heating value of the gas, when the water vapors of combustion go off as steam instead of being condensed to liquid form.

The heating value of a gas may be approximately determined if its analysis be correctly known. The analyses of all gases include only some 10 or 12 different kinds of gases which are the elementary gases of nature, and, with the exception of some more or less complex hydro-carbons, are themselves each definite in character.

ELECTRIC CABLES.*

By Henry W. Fisher.

During the winter of 1889, the writer first became connected with a cable manufacturing company. It is interesting to note the great improvements that have been made in this industry in the last twenty years.

For convenience, the different kinds of cables will be classified under three main groups, some of which will have subdivisions.

Telegraph Cables.

Less radical changes have been made in telegraph cables than in either of the other two groups. The old kind of insulation was cotton or jute impregnated with some approved compound, and there are persons to-day who still purchase cables of this make-up, in preference to paper insulated cables.

With increase in the length of telegraph circuits and changes in the instruments employed, it became necessary to reduce the electrostatic capacity, and so now dry paper insulation is used extensively, and combination cables consisting of two different sizes of conductors are frequently employed. Very often also, some of the insulated conductors are twisted in pairs so as to avoid inductive interferences from adjacent wires. The sizes of conductors employed vary from No. 18 to No. 13 B. & S. G., No. 14 being used most often. With cables of the most modern construction, good telegraphic service can be given over distances of 125 miles, and possibly farther. For the operation of quadruplex and Wheatstone instruments over such long distances, twisted pairs or their equivalent must be employed.

Telephone Cables.

The first telephone cables were insulated with cotton or jute, and afterwards paper was employed.

At first, the insulating material was thoroughly saturated with a good compound, paraffine being extensively used.

*The Sibley Journal of Engineering.

The average electrostatic capacity required between each wire and the rest connected to the lead cover of the cable was .18 mf. per mile for No. 19 B. & S. G.

As the telephone circuits became longer, it was soon found that the electrostatic capacity must be reduced, and this eventually led to the celebrated Conference Specifications of the Bell Telephone Co. requiring the use of dry paper and an electrostatic capacity of .08 mf. per mile. In the early days, much experimenting was required in trying to apply the paper on the conductor so as to include a maximum amount of air. The earlier cables for the same capacity and number of twisted pairs were much larger than those of to-day. In addition to the methods of applying the paper, experiments had to be made to find the best paper to use, both as to size and specific inductive capacity Great care has to be exercised in removing all traces of moisture before applying the lead cover, and this is done by the use of hot ovens, vacuum tanks, etc.

With further increase in the length of telephone circuits, it was found necessary to use larger conductors so that No. 13 B. & S. G. is extensively employed.

For several years back, the Bell Telephone Co. has been requiring a test of "mutual" capacity, or the capacity between one conductor of a pair and its mate with all other conductors connected to the lead cover of the cable. This capacity is about two-thirds of the capacity by the old method, where one wire was tested against all the others connected to the lead cover.

After the introduction of the celebrated Pupin loading coils, for helping to neutralize the effects of capacity, it was found that slight telephonic disturbances, due to a condition of unbalance between adjacent pairs in a telephone cable, were greatly accentuated by the use of said coils. This led to the design of a special testing apparatus for measuring the unbalanced capacity, by the Bell Telephone Co., and to a new requirement stating that the average mutual capacity unbalanced between adjacent pairs should not exceed .000025 microfarads.

To meet this extremely difficult specification, considerable experimenting was required, and the method of doing it is kept as a trade secret with those few manufacturers who have successfully made cables meeting these requirements. Cables of this sort are generally used for toll and long-distance purposes, and the sizes of conductors employed are No. 16 and No. 13, with mutual capacities ranging between .065 and .08 mf. per mile.

The specified insulation resistance is generally 500 megohms per mile. There are many interesting things in connection with the manufacture, installation, testing, and use of telephone cables which cannot be considered in this short article.

Electric Light and Power Cables.

In the early manufacture of fibrous insulated cables, jute and cotton were extensively used for the body of the insulating material, and some approved compound for the filler. This was in the days when 1000 volts was considered a high voltage, and when the use of 2000 volts was extremely rare.

In times of emergency, some of these old cables have been worked successfully on arc circuits of from 4000 to 5000 volts.

This kind of insulation is not adaptable for very high voltages, because its efficiency depends largely upon the completeness with which the remaining space between the conductor and the lead cover is filled with insulating compound.

Therefore, for high voltage transmission, we have to use materials that have more body to them, such as paper, varnished cloth and rubber.

Paper Insulated Cables.

This kind of cable has given excellent satisfaction commercially up to 22,000 volts working pressure, and when the demand for cables to operate at higher voltages is created, paper insulated cables will no doubt be supplied, although the ultimate maximum limit of voltage cannot be said to have been as yet determined.

By the selection of the right materials properly applied and treated, paper insulation can be made of remarkable dielectric strength, and the theoretical or laboratory efficiency is many times the commercial efficiency attained in practice. Continual experiments, both commercial and laboratory, are necessary to show the manufacturer in what directions improvements can be made. With paper insulated cables, the use of a lead cover is absolutely essential for the purpose of preventing the absorption of moisture by the insulation. For the same reason, the ends of the cables must be provided with suitable terminals filled with insulating compound.

The Davis open-air terminal of the Standard Underground Cable Co. effectively excludes moisture from entering the cable, and at the same affords so good an insulation between the connector and the lead cover of the cable that the terminal can be used out of doors.

Paper insulated cables are made up in a great variety of forms, such as single conductor, duplex, triplex, multiple and concentric. The last, on account of the difficulty in making joints, is not used in this country as much as other styles.

In order to reduce the effects of induction and induced currents in the lead cover, it is best to use two conductor, three conductor and four conductor cables respectively, for single phase, three phase, and two phase circuits.

At the present time there are millions of feet of three conductor paper insulated cables working at 11,000 volts in such a successful manner as to completely satisfy the operators.

Paper insulated cables saturated with a soft, oily compound, do not have as high an insulation resistance in megohms as those where a harder saturating compound is used. The former, however, are preferable on account of greater dielectric strength, greater flexibility and less liability to cracks in the paper or compound.

Varnished Cloth Cables.

When varnished cloth was first used extensively in the insulating of parts of electric machinery, there was an objection to using it in cables because the insulation resistance was too low to meet the general cable requirements at that time. Since then, engineers have realized that high dielectric strength is more desirable than insulation resistance in megohms, and so the required megohms per mile are not nearly so great now as they were ten years ago. Moreover, the quality of varnished cloth has improved so that now higher insulation resistances are obtainable.

Varnished cloth cables have a high dielectric strength, and they seem to also withstand impulsive rises of voltage very much in excess of their normal working pressure.

The power factor of the ordinary varnished cloth is higher than that of saturated paper, and hence varnished cloth cables are apt to become somewhat warm when necessary to apply very high voltage under test or working conditions.

It is possible, however, to very much reduce this effect by the proper selection of the right materials, and by the method of manufacture.

Rubber Insulated Cables.

The use of rubber for insulating purposes is so old that it is hardly necessary here to speak of it from a historical standpoint. Cables of almost endless variety are insulated with rubber and covered with lead, which would no doubt be used more extensively for electric light and power cables were it not for the fact that it costs much more than paper, and decentralizes under heat. The best commercial grade of rubber compound used in cables has about forty per cent Para and thirty per cent Para, and is used so frequently that many different specifications have been drawn up by government engineers and others setting forth the various tests which the rubber compound must meet. The main object of these specifications is to make the requirements of such a nature that compliance therewith necessitates the use of full thirty per cent fine Para, and no rubber of inferior grade.

While for high voltage cables, it is best to use compound approximating thirty per cent fine Para rubber, yet it is doubtfully expedient to use so expensive a compound for cables operating at low or intermediate voltages up to 6600 volts. The judgment of an experienced manufacturer is often a safer guide as to right construction of cables than the arbitrary use of some particular specification that may not be suitable for the conditions.

Rubber insulated wires are used to a limited extent in telegraph and telephone cables. Where such cables are laid in water or in the ground, they are frequently protected with steel armor, either in the form of two steel tapes or else in a concentric layer of steel wires.

ELECTRICAL PURIFICATION OF WATER.

It is well known that many of the common and more dangerous impurities of water are organic or bacteriac. These may be removed by electrolysis, several methods of which have been well described by Henry Leffmann in the Journal of the Franklin Institute. In one of these, aluminum electrodes have been used, more or less loss of the metal occurring, it being converted into aluminum hydroxide. This combines with the organic matter and entangles the suspended substances, so that the water, after treatment, can be subjected to a rapid filtration, and will show material improvement in microbic content, especially if the amount of suspended matter and microbic content were previously high. On waters containing but little suspended impurity, living or dead, the purifying action is relatively low. The constant loss of the electrode is a most serious item of expense, generally overlooked in the experimental plants.

In the operation of the Anderson process of purifying water by agitation with metallic iron, attempts have been made to get more powerful action—that is, more rapid solution of the iron—by making it the positive pole of an electric system, but no practical advantage seems to have been attained. Recently, a process has been patented in which an electric current is passed from an inner to an outer pipe, the water flowing through the annulus.

Probably, the most practical benefit of the application of electricity to water purification will come from the indirect methods in which the electrical energy is used to produce an active disinfecting agent, and this then applied to the water. Of all the processes of this type, those which produce ozone seem to be most useful. This modification of oxygen can be obtained by several methods, but those in which electricity is employed seem to be alone applicable to the processes in question here. For the purpose high-tension currents are most economical, and the best yield is obtained by the so-called "silent discharge." It is now known that a spark or arc discharge will produce nitrogen oxides which are corrosive. It has also been determined that the air intended for production of ozone should be dry, otherwise hydrogen dioxide will be formed. The principal mechanical difficulty encountered in producing ozone on the larger scale by means of the electric discharge is to secure a suitable dielectric. Glass, porcelain, rubber, and other materials have been tried, but are so liable to fracture or perforation that serious interruptions of operation frequently occur. Continuity of action is very important in commercial processes, such as the purification of water, and when a large unit of the plant is out of use, in order to install a new dielectric, the condition is annoying.

The inventions of Vosmaer seem to overcome the difficulty, for he avoids the use of a special dielectric, employing only the dry air which is to be ozonized. The discharge takes place from thin metal strips, on which are saw-like teeth. These strips are held by porcelain sockets firmly in the center of metal pipes. Many of these pipes are combined in parallel, the strips being all connected with one pole, and the pipes with the other. An alternating current of high potential is allowed to flow through the arrangement, almost all the current passing by silent discharge, although at times a spark passes, but as there is no permanent dielectric, no damage is done. The sparking is too seldom to produce damage or any appreciable amount of objectionable gases. The drying of the air may be done by any of the known methods. Preference is given by Vosmaer to refrigeration, by means of an ordinary ice machine.

A plant capable of purifying many thousand gallons in twenty-four hours has been for some time in operation on the west bank of the Schuylkill River at the foot of Locust St., Philadelphia. The water is first roughly filtered. This operation is merely intended to remove the grosser suspended matter, as the ozone process proper does not accomplish this. As the main part of the operation is the destructive action of the ozone on the bacteria, it is not necessary for the preliminary filtration to be nearly so close as when the latter is the sole reliance (as in ordinary filter plants), hence the filter area in the ozone plant is relatively very much smaller, the rate of filtration being so much greater. The filtered, or, perhaps, we may call it, strained water, is passed into aerating towers. These are tall, narrow vessels, into which the water enters at the top and the ozonized air at the bottom, the latter under considerable pressure. In the experimental plant above mentioned, an exhibition mixing tower has been installed. This is a glass tube about sixteen feet high and ten inches in diameter. In this the admixture of the ozone current with the water current is well seen. Upon the thoroughness of this mixing depends, in large part, the thoroughness of the purification. The water escapes at the foot of the mixing tower, clear and practically sterile. It sometimes contains a small amount of ozone in solution, but this is not objectionable, and soon disappears, either by conversion into ordinary oxygen or by combination.

The advantages of the process may be summarized as follows: no objectionable chemical is introduced into the water; large filter beds are not required; the operation expenses are not high; the plant occupies a limited area, and the operation is simple and easily comprehended; the plant may be enlarged by the addition of new units without disturbing the original units; the sterilization is rapid and certain; the plant may be placed at any convenient point. The process seems to find even more valuable application to the purification of sewage than to ordinary water supply. Both of these problems are now among the most urgent questions of sanitation.

The extensive use of water in our domestic life, with the increasing sources of pollution, give importance to every method of purification, and processes that seem to be founded on scientific principles and seem capable of practical operation on a large scale, and to involve low operative cost, limited land area and freedom from dangerous chemicals, deserve careful investigation.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX APRIL 4, 1908 No. 14

EDITORIAL.

PHOTOMETRY.

Recent improvements in methods of producing light have emphasized the deficiency in satisfactory means of accurately measuring their absolute and relative intensity. For over two hundred years scientists have been working on this subject without finding a completely suitable solution. This work has been mainly for the purpose of establishing a reliable standard for comparison, as the slight mechanical difficulties of adjusting and moving the light to be tested have been easily overcome.

A standard of light, like any other standard, should be capable of being reproduced anywhere and everywhere by means of certain specifications. It does not seem practicable to maintain a standard for light comparison in some central archives as is done for length, weight or time, yet, to be of use, the investigations should all refer to one standard or to others easily convertible. There is no more striking example of the tenacious hold that an anachronism may get in technical or popular language than is shown in the steadfast adherence to the term candlepower as the unit of light long after tallow, wax, stearine, sperm and paraffine have been successively adopted and repudiated for ordinary lighting. The appropriateness of the second part of the expression is clear, when we consider that it is the measure of the rate of the expenditure of energy that becomes evident as light. But there still remains much to be desired in a more perfect standard of expression as well as of measurement.

The cause of this inexactness in nomenclature is based upon the lack of a universally acknowledged standard of intensity. Thus we find the English standard candle, the Carcel lamp, the Hefner and the Vernon-Harcourt pentane lamp, specified by various organizations and communities, with a preponderance of scientific use in favor of the Hefner. This is an open-flame lamp of precise dimensions, burning amyl acetate in a cotton wick adjusted to give a flame of definite height. Any variation due to the changes of barometric pressure, moisture and carbon dioxide present in the atmosphere are corrected from carefully prepared tables, but even these precautions do not compensate for the weakness of the flame, its red color and the intensity variation, with change in height. While probably the most reliable standard to date, it yet has much room for improvement. The relative value of these standards has been settled by the International Photometric Commission by stating that one Hefner is equivalent to 0.0930 Carcel and 0.0915 Vernon-Harcourt, it being generally assumed that the Hefner is equal to 0.88 English candle.

Because of the priority of gas lighting, the history of this development has been more closely identified with it than with electric lighting. It seems possible that the exact measurements and refined conditions under which an electric light can be produced may ultimately lead to its adoption for this purpose, especially with the metallic filaments now available. At present it is the most important secondary standard in general use.

Having adopted some standard of intensity, the next point is to standardize the direction of measurement, which may be either spherical, horizontal or lower hemispherical, according as the light is measured in all directions, in a direction of 45 degrees, or in the lower hemisphere of the plane of the source of light. The average or mean, obtained by rotating the light at a unit distance, gives the measure of illumination.

Slight changes in principle have been made in various photometric devices since the time of Bunsen, these improvements being mainly for convenience and portability. For rapidity and easy working a portable German instrument has been constructed which gives by direct reading the watts consumed, the horizontal candle and the watt per candle. Another new principle has been introduced in the flicker photometer in which two sources of light are alternately thrown on the same point in rapid succession. As a consequence, if unequal, the spot will flicker; when equal, it will remain constant.

This discussion has been limited to its scientific, rather than its practical application, the latter involving many other factors, such as wall-paper reflection or absorption and fixture design, which are not considered in the mere laboratory measurement. Unfortunately for accuracy, all these methods are limited in precision to the sensibility of the eye and are

consequently not so much physical as they are physiological, each depending largely upon the personal equation of the observer. There is probably no subject that offers a more attractive field of research than the problem of establishing a standard, for any predetermined color value, that can be defined in the terms of units of radiant power. These can be used as a primary standard with which the practical secondary and subsidiary standards could from time to time be compared.

PERSONAL.

R. Leo Van der Naillen, of Santa Rosa, has accepted the position of local manager of the Oroville Water, Light and Power Company.

George A. Scoville is in San Francisco to open a local branch house of the Dean Electric Company, of Elyria, Ohio. A full line of telephone apparatus will be carried.

Mr. C. C. Hillis's brother, Edward W. Hillis, has been for the past week a visitor among us. He left for the North, Wednesday, April 1st. Mr. Hillis's genial personality will always insure him a hearty welcome on his return.

Mr. Walter S. Heaton, of the Ohmer Fare Register Co., Dayton, Ohio, is in the city, having removed his headquarters from Los Angeles, where he has been for a number of years representing this company on the Pacific Coast. The Ohmer Fare Register Co., of Dayton, Ohio, is too well known to need any introduction from the "Journal."

Mr. C. E. Nestor, president of the Pacific Telephone Construction Co., was in Fresno the first of the week, and expects to arrange for the construction of some new country telephone lines in this vicinity in the near future. The Pacific Telephone Construction Co. is organized to develop the country lines, working in conjunction with the Pacific Telephone and Telegraph Co.

Mr. J. E. McGillivray, of the American Electric Telephone Co., has just returned from an extended trip through the country, and reports a great development in the growth of rural telephone lines. Mr. McGillivray's company is at present furnishing the equipment for new telephone plants at Cliffs, Wash., Chelan, Wash., and for a 100-line board and complete equipment at Hermiston, Oregon.

W. T. Goddard, electrical engineer of the Locke Insulator Manufacturing Co., is making an extensive trip through the West investigating high voltage insulator applications and transmission line and power house design. Mr. Goddard is making a special study of the influence of various climatic conditions upon the design of insulators for various localities, especially in view of designs for 100,000 volts and higher.

Mr. F. G. Waterhouse, general manager of the Southern Nevada Consolidated Telephones and Telegraph Co., has been spending some time at his home at Bolinas, near Sausalito. The Southern Nevada Co., of which Mr. Waterhouse is the directing head, operate exchanges at Manhattan, Tonopah, Goldfield, Rhyolite, Beatty, and Greenwater, and cover the entire Nevada gold country with a network of long distance lines.

REMOVAL NOTICE.

Mr. W. A. Eckberg, representing the following concerns, The Hart Mfg. Co., Frank Adam Electric Co., Condit Electrical Mfg. Co., The Peerless Electric Co., The Sachs Co., Enameled Metals Co., Hartford Time Switch Co., Willard Storage Battery Co., on the Pacific Coast, is now located in his new offices at 143 Second St., San Francisco.

OBITUARY.

Mr. Lester A. Pelton, the inventor of the Pelton waterwheel, died March 15th, at Oakland, California, aged 78 years. He came to California in the gold rush of 1849, and first used his wheel to develop power for gold mining in California. It is given to but comparatively few men to invent

a device that so materially affects the prosperity of a great industry as has the Pelton wheel influenced the utilization of water for power. Fewer still live to see the success of their proposal as tried by the test of time. Mr. Pelton was born at Vermillion, Ohio, in 1830, and has lived in California since 1849. His invention as developed by engineers has become almost synonymous for impulse wheels, and forms a lasting monument to his memory.

TRADE CATALOGUES.

The Steel City Electric Co., of Pittsburg, Pa., sends an illustrated folder describing Fullman water-tight floor outlets, National Code standard.

J. N. Kelman, 1000 North Main Street, Los Angeles, Cal., sends an interesting folder of the Kelman "Short-Circuit" Breakers, automatic, high voltage oil break.

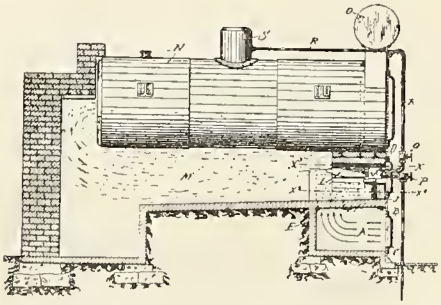
Bulletin No. 20, from the H. Krantz Manufacturing Co., 160-166 Seventh Street, Brooklyn, N. Y., illustrates and describes a beautiful line of standard and straight line panel boards and accessories.

Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., send a number of valuable booklets. No. 1104 deals with Westinghouse portable and precision meters, which are constructed not only for high initial accuracy, but also for permanency. This bulletin is replete with details of ammeter and voltmeter construction, and much matter of interest has been condensed in its 54 pages. No. 1135 illustrates and describes Westinghouse No. 114 and No. 134 railway motors for direct current service, containing many new and up-to-date features of motor construction. No. 1097 similarly displays types K and KG motors, direct-current, series wound, for use on cranes, hoisting machinery, etc. The Westinghouse No. 92A railway motor, direct-current, with a nominal rating of 35 horsepower, appears in Bulletin No. 1100. No. 1149 is devoted to type C transformers, single and three-phase, for mounting in man-holes. Folder 4049 shows Westinghouse type F circuit breakers.

PATENTS

MEANS FOR BURNING OIL. 882,205. Thomas C. Mason, Los Angeles, Cal.

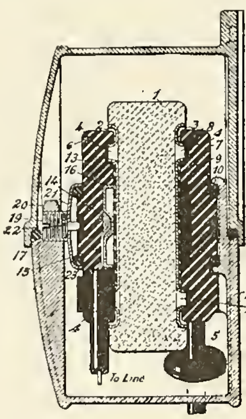
The apparatus for effecting the complete combustion of oil, consisting of a bottom chamber, doors at the front of said chamber, openings one at each side and at the inner end of the bottom chamber leading into lateral flues, one such flue on each side of the apparatus, a transverse flue



uniting the lateral flues, the single central discharge flue having curved walls projecting inwardly to the lower part of the combustion chamber, the flue having curved walls, being of gradually decreasing cross-sectional area, a burner in the combustion chamber, pipes connecting the burner within the combustion chamber.

LIGHTNING-ARRESTER. 882,265. Newitt J. Neall, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.

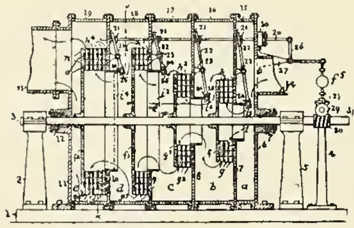
In a lightning arrester, the combination with a discharge block and conducting plates provided with lateral projections and secured to the faces of said discharge block, of insulating blocks that support the discharge block, and are provided with central recesses and with other recesses into



which the lateral projections of the conducting plates are seated, a terminal plate located in the central recess in one of the insulating blocks and provided with a boss, insulating sheets having apertures interposed between the terminal plate and one of the plates on the discharge block, and directly opposite the boss on the terminal plate, and means for clamping the parts together.

TURBINE-MOTOR. 882,127. Byron Stevens, Oakland, Cal.

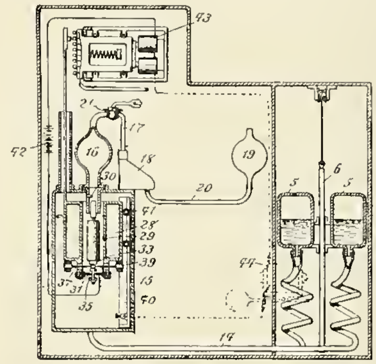
A turbine-motor composed of a series of chambers, a shaft extending through the chambers, a series of wheels in the chambers, each composed of a movable part and an immovable part, the former part being connected to the shaft while the latter part is connected to a wall of a chamber,



the vanes of the wheels being located in inter-leaved tubes alternately connected to said parts, a central fluid inlet for each wheel, a regulating valve in said inlet, and a governor or regulator adapted to operate the valves.

AUTOMATIC GAS-ANALYZER. 881,986. Henry J. Westover, New York, N. Y.

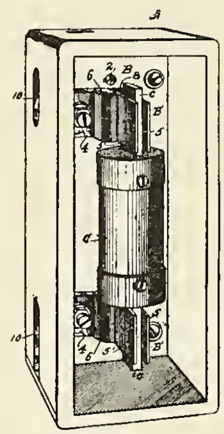
A device for controlling electric circuits in correspondence with the proportion of a given gas in a mixture, comprising two independently movable floats electrically con-



nected to each other, an insulated plate borne on one of said floats, a contact point upon the other float adapted to touch said plate, and an electric circuit, one side of which terminates in said plate and the other in said floats.

FUSE AND FUSE-BOX. 881,965. Frank L. Sessions, Columbus, Ohio, assignor, by mesne assignments, to The Jeffrey Manufacturing Company.

A fuse-carrying device comprising a pair of fuse-carrying elements, each element consisting of a pair of flat plates

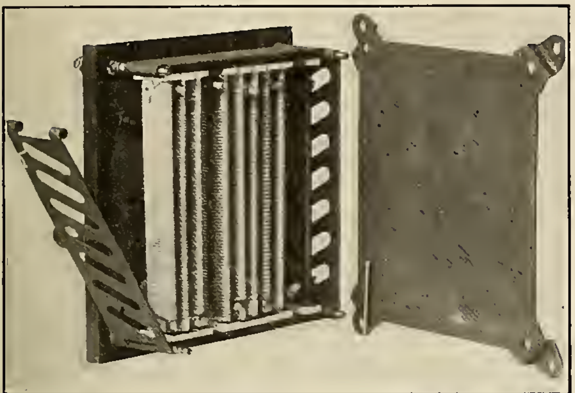


arranged parallel to each other and adapted to receive between them one terminal of a fuse, means for adjusting the plates of each carrying element relatively to each other, and means for adjusting the pairs of plates relatively to each other.

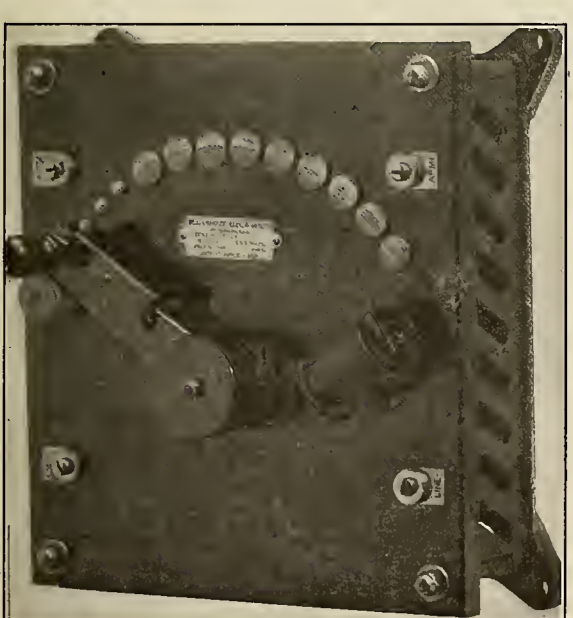
INDUSTRIAL

WESTINGHOUSE DIRECT-CURRENT STARTING RHEOSTATS.

Direct-current motors, except in the smallest sizes, require some sort of starting device, to keep the current within safe limits, and also to prevent the motor from starting with too great a rush. The necessity of using satisfactory starting devices is therefore as great as to have the motor itself reliable. The Westinghouse Electric & Mfg. Company has developed a line of face-plate starters which are thoroughly satisfactory and fully meet the specifications and conditions laid down by the National Board of Fire Underwriters and the American Institute of Electrical Engineers.

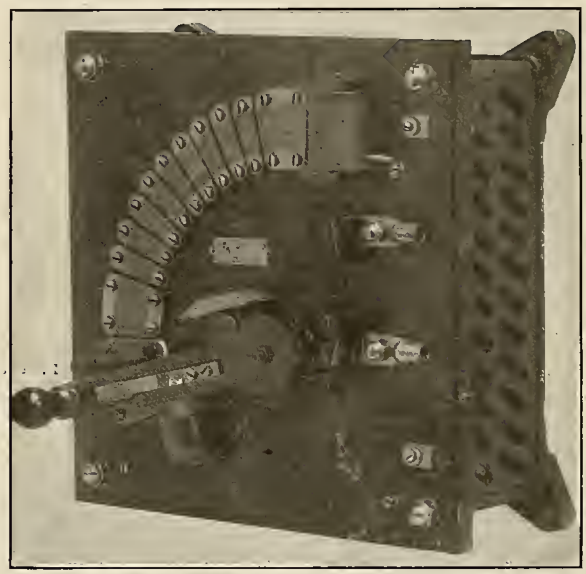


BAR TYPE STARTING RESISTANCE OPEN FOR INSPECTION.



FACE PLATE STARTER 80 AMPERE CAPACITY.

All starting rheostats are intended for use only when bringing the motor up to speed, and are not designed for regulating the speed. Speed-regulating rheostats may be obtained, but they are intended either to vary the field current of the motor, or else they must be able to regulate the much larger armature current. The rheostat which regulates the armature current must be capable of carrying the full line current continuously. Therefore this type of rheostat is considerably more expensive than the starting rheostats which are in service for only the short and infrequent periods of starting. The lower cost of the starting rheostat does not interfere with its absolutely satisfactory operation for the intermittent service of starting for which it is designed.

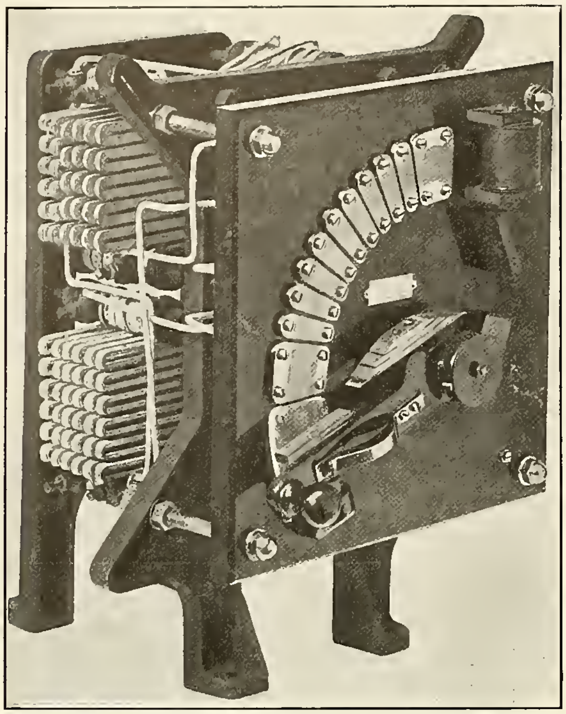


FACE PLATE STARTER 160 AMPERE CAPACITY.

The starters for motors on 110 volts up to 22 horsepower, or 220 volts up to 35 horsepower, use the bar type of resistance, which consists of a resistance wire wound on iron bars which are first covered with a fireproof material. The ends of the bars are held in place by porcelain pieces, clearly shown in the illustrations. The construction is strong and rigid, so that adjacent turns on the same bar cannot short-circuit, nor can turns on one bar come in contact with turns on another bar. The whole construction, resistance, iron frame, slate front, contact arm, etc., is fireproof.

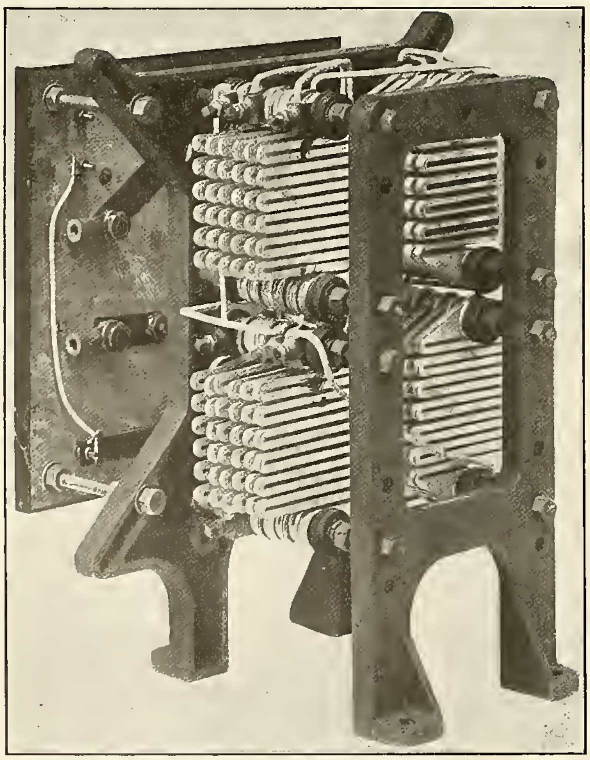
Another feature embodied in these starters is the low voltage release. The contact arm will positively fly back to the off position if the current is shut off from the line, or if the voltage falls below a fixed limit. This prevents damage to the motor should the current again be thrown on or the voltage rise suddenly to its full value. The method of connecting the magnet of the release coil will be found of special benefit where the field of the motor is to be regulated. The magnet is connected across the line independently of the shunt field and is unaffected by variations in the field current.

The small button type of rheostat shown in the illustration is used on the smaller types of motors, and is



32996—GRID TYPE STARTER 240 AMPERE FACE PLATE.

capable of carrying 80 amperes. For the larger motors larger contacts are required; this requirement is met by



32995—GRID TYPE STARTER 240 AMPERE FACE PLATE, REAR VIEW.

furnishing renewable contacts, as shown in the illustration of the 160-ampere rheostat. In this larger type of starter a special short-circuiting brush is provided which cuts out the last contact, insuring the lowest resistance possible.

For starting motors on 110 volts of 25 horsepower or 220 volts, 45 horsepower and larger, the grid type of resistance is used, which is fully ventilated and will stand the heavy duty required in starting large motors. All contacts, brushes, fingers and springs may be removed from the front with ease.

The line of rheostats is described in Leaflet No. 9,000, with full information as to dimensions, carrying capacities, etc. This line of starters is adapted for 110, 220, and 500-volt motors.

As these rheostats are used only in starting, the handle will not remain on any point except the last, unless held. They are intended to bring the motor up to speed in 15 to 30 seconds, according to size, and are made for full-load conditions.

A NEW LOCKING SOCKET.

A special lamp socket has recently been placed on the market by the General Electric Company, which should prove a boon to hotel managers, factory owners, managers of amusement resorts and others who suffer lamp losses by petty thievery.

In the old style of locking socket the lamp was held rigid in the socket, and attempts to remove it generally resulted in breaking the globe. In the new style the screw shell turns freely and the lamp cannot be removed until the shell is locked with the key.

The socket is shown in the accompanying illustration, and it should be noted that the addition of the locking feature has been made without detracting in any way from the neat appearance of the standard socket.

This locking socket should also appeal to those who had contemplated using the higher priced tantalum and tungsten lamps, but who had deferred doing so on account of the extra inducements offered to the sneak thief.

The rapid advance of the Dossert solderless connectors in the trade is shown by the steady increase in orders received for these remarkably efficient labor-saving devices. Among recent orders received by Dossert & Company, 242 West Forty-first Street, New York, are third rail clamp connectors for 1,000,000 C. M., cable from the New York Central & Hudson River R. R. Co., cable taps 400,000 C. M., main to 0000 bleeder from the Chicago City Railway Co., and cable taps for 1,000,000 C. M., cable from the Syracuse & South Bay Electric Ry. Co.

NEWS NOTES

TRANSPORTATION.

Reno.—The Virginia and Truckee Electric Railway Company is planning on changing its line to an electric system. Chief Engineer Kirk of the road was in Reno the first of last week conferring with City Electrician Caffrey.

Riverside.—Wiring has been begun on the trolley line to Crestmore, where a large cement plant is situated. The road is about 6 miles long, and will be operated by the Arlington R. R. Co., which is owned by H. E. Huntington.

Reno.—Within 60 days the cars of the Reno Traction Company and the Interurban Railway Company will be running over Center and Second Streets from the new terminal to be provided at the intersection of Center Street and Commercial Row.

San Francisco.—The Board of Supervisors has adopted a resolution allowing the United Railroads Company to use the Sutter Street tracks on the lower end of Market Street for trolley purposes for 15 days more, pending some permanent settlement of the questions involved.

Stockton.—The first decided step taken to construct a road through the Manteca French Camp and Ripon district to the south and east of Stockton last week, when articles of incorporation of the San Joaquin Investment Company were filed. One of the principal objects of the corporation is to secure rights of way for the electric road, which will be built by the Central California Traction Company.

Oakland.—The late car service on the Oakland and Berkeley lines of the Oakland Traction Company is to be restored. E. A. Heron, president and general manager of the Oakland Traction Company, has assured the Merchants' Exchange of Oakland that in the near future cars will be running on the company's lines that will connect with the last Key Route ferryboat, and also accommodate late visitors from Oakland.

Visalia.—The Visalia electric line will begin operations in a few days between Visalia and Lemon Cove, in Exeter. The Visalia Electric Railway owns its own tracks in the city of Visalia, and also between Exeter and Lemon Cove, and has obtained trackage rights between Exeter and Visalia from the Southern Pacific. It is estimated that next season 250 carloads of citrus fruit will be moved from this section.

San Jacinto.—Talk of the proposed electric road from Redlands to San Jacinto and Hemet is being revived, and the matter will be made the subject of discussion at the next meeting of the Board of Trade. A preliminary survey for the trolley road was made about a year ago, at a cost of several hundred dollars, but since then nothing further has been done. W. F. Whittier is willing to build it, according to report.

Oakland.—Within a few weeks the mile of narrow gauge track that at present connects with the Oakland-Hayward car line a mile out of Hayward, will have been transformed into broad gauge, and the cars of the Oakland Traction Company will run direct into Hayward. This improvement will cut several minutes or more from the running schedule, as much time is lost in transferring at the point a mile distant from the center of town. Recently the engineers of the Oakland Traction completed the survey of the line of track, and last week workmen began laying a stretch of broad-gauge rails. The Hayward cross lines will also be broad gauged, and the larger cars of the Oakland Traction Company put in service in the suburban town.

WATERWORKS.

Biggs.—W. M. Doty, of this city, has been awarded a contract to erect and install a sprinkling plant by the Board of Supervisors. This contract will require two large iron tanks, and some 4,000 feet of piping, which will be connected with the city water system.

Ogden, Utah.—As preliminary to the erection of a municipal power plant and the installation of a municipal water system, A. E. Parker, city engineer, acting under the direction of Mayor Brewer and the City Council, filed two applications with the State engineer for water in South Fork Canyon, a tributary stream to the Ogden River.

San Francisco.—Unless some settlement of the Reis tract water war is effected immediately the water to all consumers will be shut off, according to an official announcement made by the County Line Water Company. T. B. Potter, the principal owner of the County Line Water Company, was unable to attend the recent meeting held by the citizens, but addressed a letter, in which he said: "Should the people of the Reis tract decide not to accept the offer made by me, and can induce either the city or the Spring Valley Water Company to furnish the entire district with water, I will make a free gift for this purpose of all the pipe lines in the streets in this district now belonging to the County Line Water Company, provided immediate action is taken." Mr. Potter's offer was, in substance, to sell water at $2.10 per month per lot, providing 300 consumers signed an agreement to take one share of the stock free in the County Line Water Company, thus making it nominally a mutual concern, but while 117 have so agreed, 183 refuse to sign. Mr. Potter claims that it costs $510 per month to operate the plant, and that the consumers must meet this cost or the water plant will be closed down.

OIL.

Santa Maria.—The Union Oil Company is now awaiting confirmation of the sale of the Teresa Bell tract, and will immediately erect a derrick and begin operations on this land. This property was recently bid in by this company for $440,000. Its northern line runs parallel with the Blochman property, the Palmer well being not more than 100 feet from the line.

San Francisco.—Henry J. Crocker, of the California Petroleum Refineries, entered a denial last week to the report that the big plant at Oilport was to be sold. The report followed the arrival of John Hay, of London, who represents the English capitalists interested in the plant. Mr. Hay is now at Oilport, but, according to Mr. Crocker, his visit there is merely for the purpose of inspection.

Pasadena.—The annual meeting of the Revenue Oil Company was held March 18th. Secretary R. H. Pinney reported that the year's receipts amounted to $41,000, this being under the old contract of 27 cents per barrel. Under the new contract the coming year's output has been sold to the Associated Oil Companies for over 60 cents per barrel, and it is expected that the output will be 9,000 barrels each month. At the last meeting 135,000 of the 200,000 shares were represented. The directors elected included J. F. Ker, Thomas Earley, C. B. Scoville, C. H. Hamilton, and Isaac Vailey.

INCORPORATIONS.

Orange, Cal.—The Juego Land & Water Company has been incorporated with a capital stock of $10,000. The place of business is Los Patos.

Seattle, Wash.—The N. & S. Electric Company has been incorporated with a capital stock of $24,000 by Robert Wilhelm and Wilson Niedergesaess.

Los Angeles.—The United States Electrical Manufacturing Company has been incorporated by Timothy Mahoney, J. R. Amestoy, W. J. Sheriff, G. Russo and Edgar Sharp. The capital stock is $200,000.

Santa Rosa, Cal.—The Chileno Valley Telephone Company has been incorporated with a capital stock of $5,000, by C. G. Martin, M. De Martini, H. Juhl and A. J. Bloom of Marin County, and J. L. Schwobeda of Sonoma County.

SITUATIONS WANTED

ENGINEERING SUPERINTENDENT of construction, ten years' experience, including dam construction, reinforced concrete, rock and earth excavation, submerged tunnel construction and harbor construction work. Desires position at once. Address box 10, Journal of Electricity, Power and Gas.

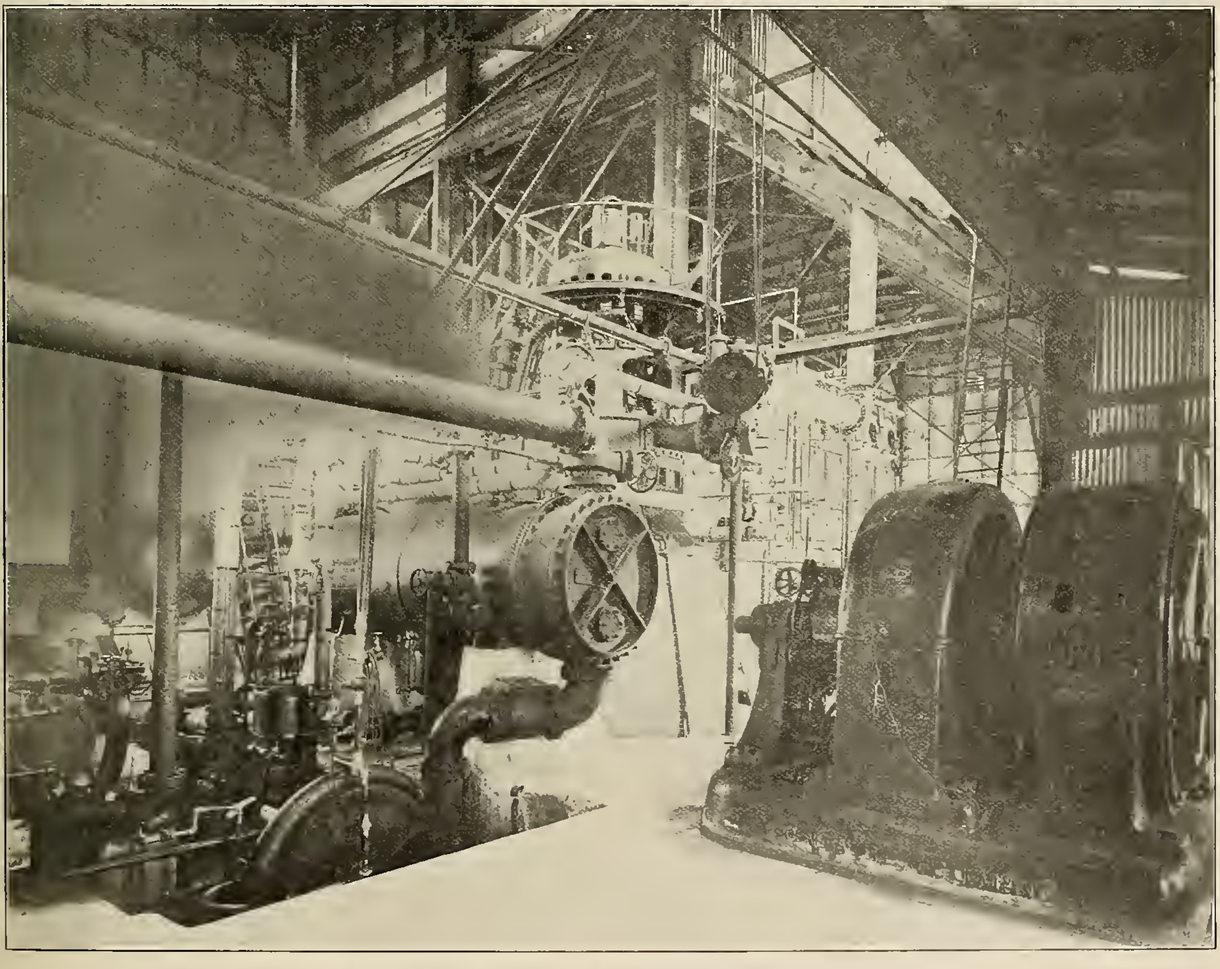
THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., APRIL 11, 1908 No. 15

MONTEREY NEW TURBINE-ELECTRIC PLANT.

There is nothing more indicative of the spirit of progress than the scrapping of old plants when new and better apparatus is available. This is exemplified in the new steam turbine installation at Monterey, Cal., which has replaced the steam-electric plant which was finished in January, 1903. This plant, which was fully described in the "Journal of Electricity, Power and Gas" of September, 1904, together with the plant at Salinas, Cal., was taken over in December, 1906, by new men, and operated as the "Monterey County Gas and Electric Company," which, in itself, is the result of the consolidation of the Monterey Gas and Electric Company which was incorporated April, 1902, and the Salinas Water, Light and Power Company, which was formed in 1901. The condition of the plants taken over by the new company was found to be bad both at Monterey and Salinas, as regards quantity and quality of service, demanding immediate attention to produce order out of chaos. Monterey was taken in hand first.

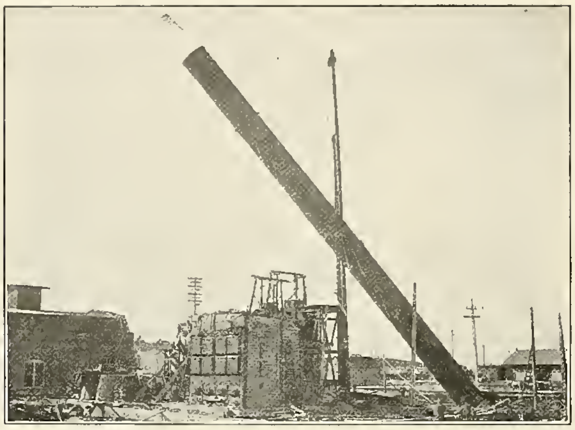


STEAM TURBINE, GENERATOR AND MOTOR GENERATOR SET.

In the old plant three 150-horsepower return tubular boilers were supposed to furnish steam for three Corliss engines aggregating 500 horsepower. Belt-driven from these were three National Electric alternators, furnishing two-phase current at 60 cycles and 2300 volts, having a total capacity of 550 kilowatts. In addition there was a 160-kilowatt motor-generator set and an auxiliary unit of 100 kilowatts driven by a 100-horsepower Corliss engine. At the time the plant was taken over, it was inadequate to meet the demands of the lighting and railway systems supplied and was causing great dissatisfaction and complaint among consumers. The voltage was low at peak and minor accidents often compelled a shut-down of one or more feeders. General Manager W. H. P. Hill at once called the attention of the directors to these conditions, and they determined to install a new generator station of sufficient size, not only for immediate needs, but also for possible growth, together with a reserve capacity to guard against ordinary shut-downs.

As a result of this decision there has just been installed one of the most modern electric power plants in the West. It consists essentially of two 500-kilowatt Curtis turbines, each driving a General Electric 2300-volt, three-phase alternator. The plant is run condensing, salt water being pumped from Monterey Bay.

The boilers and all auxiliary apparatus were supplied by Chas. C. Moore & Company, engineers, of San Francisco, the General Electric Company furnishing and installing the turbine, generators, railway motor-generator set and switchboard. This apparatus is all housed in a corrugated iron building with steel roof trusses and supporting beams, the foundations being of concrete, as shown in the accompanying picture. The handling of the apparatus is facilitated by a 10-ten, hand-power crane, giving access to all parts of the generator room. As the plant consists of two similar units, the description of one will suffice for both.



RAISING STACK, SHOWING BOILERS AND CONCRETE FOUNDATIONS.

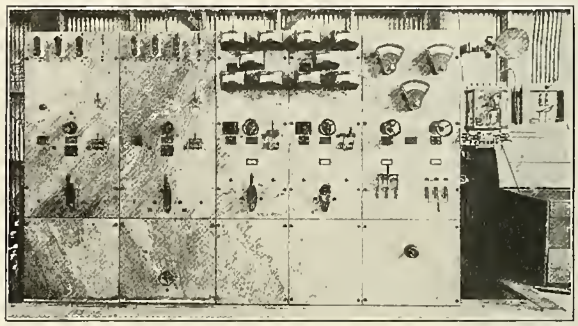
The Curtis, as is well known, is a vertical impulse turbine, the machines in question having two stages and utilizing the steam from the boiler pressure of 150 pounds down to a vacuum of about 28 inches. This vacuum is produced by Wheeler pumps 6x14x10. One of the most important features in the equipment is the step-bearing, by means of which the weight of the turbine and generator is supported on a thin film of oil supplied at 230 pounds pressure by Worthington pumps. So slight is the friction that the mass continues to revolve for an hour and forty minutes after the steam has been shut off, and the vibration is so little that a dollar can be balanced on the machine while it is running at 1800 revolutions per minute. The oil from the step-bearing is continuously circulated, being run through a Turner filter to cleanse it. The oil for the guide vanes and for the hydraulicly operated valves is delivered through a baffler from the same pump that furnishes oil for the step-bearing.

The exhaust steam is condensed in a Wheeler condenser of 2350 square feet, salt water being pumped from the bay by means of an 8-inch centrifugal pump, direct driven by a 6x6 Wheeler engine. The pumping system is an adaptation of the previously existing plant, and it was found that air in the pipe lines interfered with the continuous supply of water. To avoid this a 9x10 Westinghouse air pump, locomotive type, was connected with centrifugal pump and the high point in the line so as to remove the air, after which all worked satisfactorily. From the condenser the hot water is pumped to a Cochrane feed-water heater by a 6x10x10 Wheeler direct-acting pump, the feed to this hot well pump being automatic. Thence the water is pumped to the boiler by Snow steam pumps. The water is bought from the Pacific Improvement Company and forms the only weak link in the chain of an otherwise highly efficient system, its cost being high and its supply not wholly reliable.

Steam is supplied by two Babcock and Wilcox boilers which contain two drums and in which are 120 4-inch tubes, 10 high, 12 wide, and 18 feet long. The drums are 36 inches in diameter, three-eighths of an inch thick, and 20 feet 4 inches long. These are made of open hearth steel and rated at 160 pounds pressure and 250 horsepower. Arrangements will be made for additional boiler equipment as the capacity of the plant demands, and so fast is the current consumption increasing that this necessity has already been felt. The boilers are oil burning, the oil being furnished by two Snow pumps, each 4½x2¾x4.

The generator is a General Electric 500-kilowatt, three-phase, 2300-volt, 4-pole alternator, revolving at 1800 revolutions per minute. The fields are excited by an 80-ampere, 125-volt, type M. D., General Electric dynamo, direct connected to a General Electric Marine engine with 6½x5-inch cylinder, running at 450 revolutions per minute.

All this is controlled by a 7-panel switchboard, two railway panels not being shown in the accompanying picture. The first two panels shown are outgoing railway feeders, each being equipped with fuse blocks and switches. The third and fourth are generator panels, one for either machine. They are each



SWITCHBOARD.

equipped with three Thomson ammeters, one for each phase, and one Thomson ammeter showing the current going to the armature of the generator, one Thomson voltmeter, one 100-ampere, 250-volt, General Electric field switch, and one 500-kilowatt, 2300-volt, 125-ampere rheostat. The fifth is the exciter panel and is equipped with two Thomson astatic ammeters, one for each exciter, one voltmeter and one rheostat, the exciters being capable of being switched to either machine. The lower rheostat controls the Terrill regulator which is shown to the right of the last panel and ensures accurate voltage control for the system.

The newly installed railway motor generator set consists of a three-phase General Electric induction motor, 60 cycles, 2300 volts, 110 amperes, and a type M. P. C. direct-current dynamo furnishing 300 kilowatts at 500 volts. The old two-phase motor generator set will be used as a reserve, being supplied with current by means of two phase-reducer type H transformers.

Owing to a break-down in the old plant, one of these turbines had to be started several days before the time stated, but it ran continuously for fifty-four days without a shut-down, and that because of defective packing on a steam valve. Since then the run has been exceedingly satisfactory.

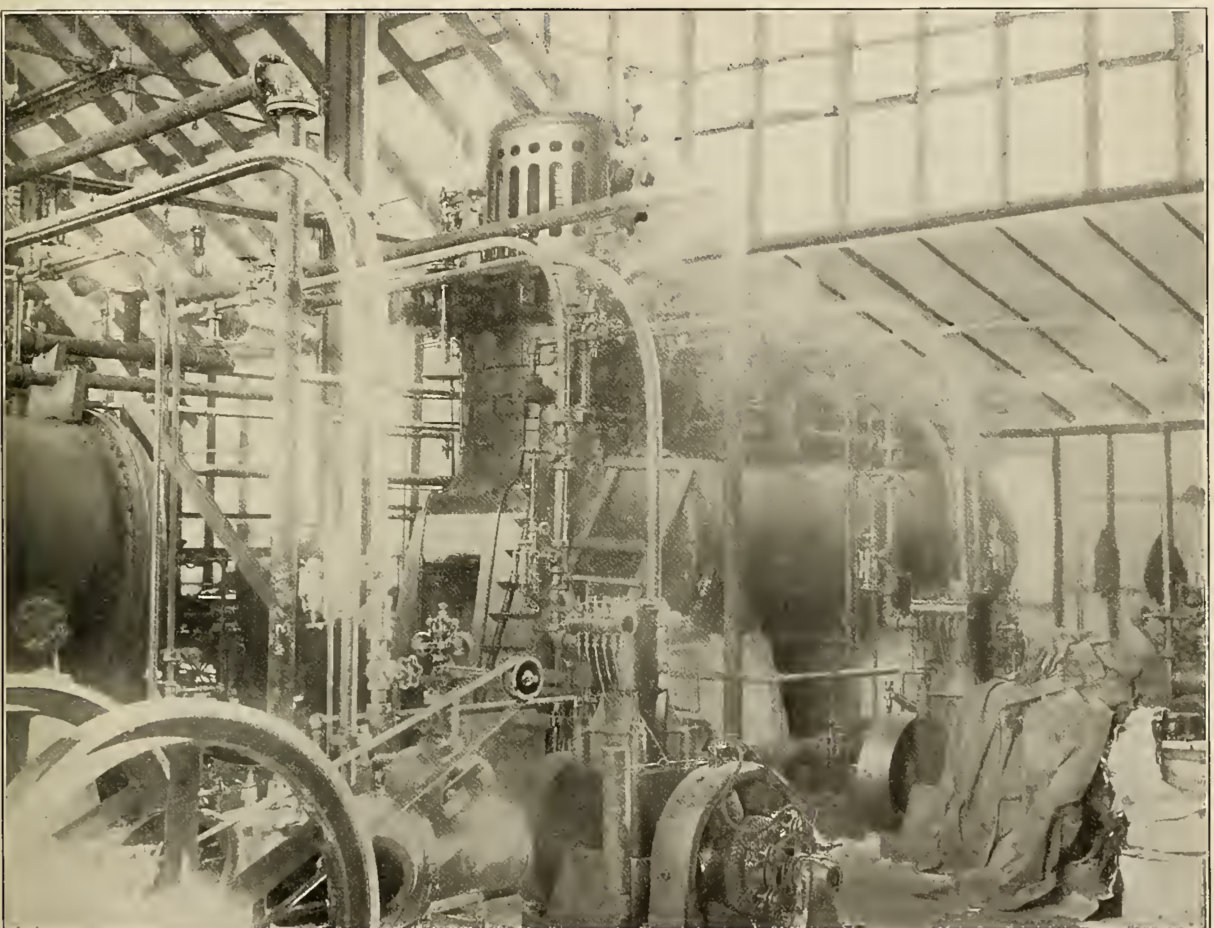
Street Railway.

As has already been indicated, this company not only supplies current for lighting, but also operates the street railway service between Monterey, Del Monte, Pacific Grove and environs, a total of 5.6 miles of main line. It was formerly subject to many breakdowns and delays and had a somewhat irregular schedule. Under the new management these have been largely eliminated and improvements are now in contemplation which include the complete rebuilding of the trolley feeder and a broadening of the track gauge. The press of

traffic and the demands upon the management's time due to the installation of the new power station, has deferred much of this improvement. Additional cars have already been put on, making twenty minutes headway on the main line. The time of operating has been increased to 19 hours from 17½. There are ten cars in all, two having been rebuilt in the company's own shops. These include two 34-foot combination 8-wheelers, which are equipped with two 35-horsepower Westinghouse motors and General Electric K. 10 control; one 34-foot closed car with similar equipment; two 34-foot open cars with two Walker 25-horsepower motors and General Electric K. control; two 28-foot combination cars with the same equipment, and two 20-foot 4-wheel dinkies. The machine shop has sufficient capacity to handle all the heavy part of the cars and power plant and has consequently considerably reduced the maintenance cost. This equipment includes a Barnes No. 5 26-inch drill press, McCabe 22-foot bed, 50-foot swing, lathe, and 150-ton hydraulic wheel press.

Gas Plant.

The company also supplies gas to Monterey and suburbs, using the Lowe process. This plant was installed in the early part of 1903. The generator, superheater, washer, scrubber and scrubber condenser being contained in separate shelves, in accordance with the practice at that time. Details of this plant were given in the "Journal of Electricity, Power and Gas" in September, 1904. Since then the pipe line has been completed from Coalinga and the oil is now piped directly to the plant. The mains were originally laid without a definite system and many gas complaints were traceable to deficient distribution rather than insufficient generator capacity. For several months a systematic examination and to some extent a rebuilding of branch mains was carried out, but the consequent increase of business occurring simultaneously with efforts to improve the old service brought the company face to face with the necessity of installing additional gas-generating plant within the coming year. Other troubles have been met and overcome, such as compressor breakdowns, failure of the motive power, etc., but these are ordinary incidents in the operation of small gas plants. During the past year the amount of gas manufactured has averaged one and one-half million cubic feet per month, but this will probably be doubled within the next eighteen months. Some tentative plans have been made regarding a new high-pressure system in connection with a new gas plant, the present pressure being three pounds. When this material is added, it will be fully described in an early issue of the "Journal."



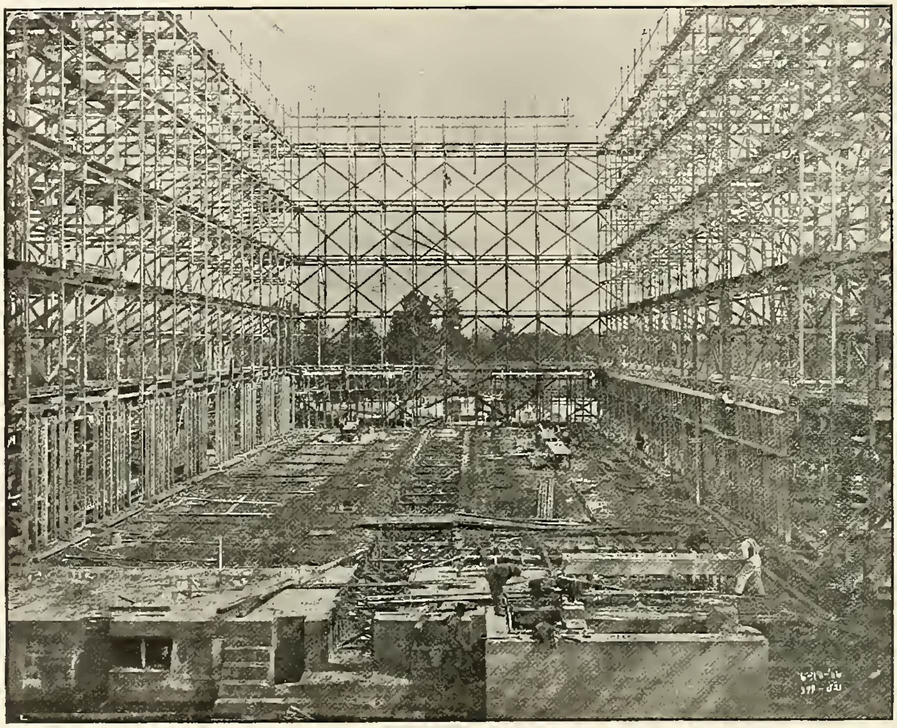
INTERIOR OF POWER PLANT.

Thus concludes another chapter in the development of the power and light supply of Monterey County. Great credit is due to Mr. W. H. P. Hill, general manager, and Mr. F. J. Sutherland, general superintendent, for the energetic manner in which they have accomplished this work of operation and simultaneous rebuilding in the face of contending odds. The officers and directors of the Monterey County Gas and Electric County are Mr. H. Hazleton, President; Mr. J. M. Gardiner, Vice-President; Mr. H. R. Hudson, Treasurer; Mr. Burke Corbett, Secretary, and Mr. C. K. MacIntosh. To Mr. Sutherland and his assistants as well as the General Electric Company and Chas. C. Moore & Co. of San Francisco we are indebted for the information in this article, and to Mr. Chas. Libhart for the photographs illustrating it.

REINFORCED CONCRETE POWER STATION.*

In the wide range of construction where reinforced concrete is displacing other materials, no field is more promising than that of power stations and other structures which house heavy machinery. In general, such structures require to be of permanent character, free from vibration and fireproof. No other material can compete with reinforced concrete where permanency and freedom from vibration are requisite.

Structures formed with members whose stiffness and rigidity depend on joints and connections being made up with a number of individual parts cannot compete in cost with those constructed with a material which can be moulded in place and become a monolith.



INTERIOR VIEW OF STAGING. FOUNDATIONS ARE COMPLETE, AND SIDES AND BOTTOM OF TRENCH IN CENTER OF BOILER ROOM HAVE BEEN CONCRETED. FORMS FOR THE OUTSIDE WALLS OF BOILER-ROOM UP TO THE BOILER-ROOM FLOOR LEVEL ARE IN PROGRESS.

Notwithstanding all that may be said for or against any material being fireproof, the most important feature of any fireproof structure, no matter what its material, is that when subjected to high temperature and suddenly cooled, its elements will not be injured nor its structural strength affected beyond repair at reasonable cost. Any structure formed with members which are solid and monolithic and non-inflammable will compare favorably with any other structure built up with a number of individual parts more or less rigidly fastened together.

The Georgetown Power Station, owned by the Seattle Electric Company, a corporation managed by Stone & Webster, of Boston, furnishes power for the electric and cable railways and the electric lighting business of Seattle, Washington. The structure is a unit which it is intended to duplicate from time to time as necessity demands.

The engine room is 64x79 feet, with a height over all of 80 feet. A 300-kilowatt Turbo-generator, with other accessories, is installed in this space. There is also space for another Turbo-generator of 500-kilowatt capacity to be installed in the future. The large generators occupy the center of 44 feet of the south side of the room, the balance of the space being taken up by accessories, locker rooms, offices, and switchboard. The switchboard, locker rooms, and offices are arranged in gallery floors on the north side of the engine room.

The area of the south side of the engine room, 44x78 feet, is covered by an electric crane of 50 tons capacity, the height in the clear being 54 feet. All equipment within the area covered by this crane is handled and set in position. Future renewals and repairs of equipment will also be handled and set in the same way. The 16x56-foot area in the north side of the engine room, directly beneath the switchboard gallery, in which are located two 500-kilowatt motor generators, a 75-kilowatt exciter, two 100-kilowatt and two 500-kilowatt transformers, is covered by a traveling crane of 10 tons capacity.

The boiler room adjoining the engine room is 154x77 feet, with an extreme height of 68 feet. This space is divided into three bays, the batteries of boilers being one each side of center of the building.

Unlike the engine room, which is a clear story from ground floor to roof, the boiler-room floor is 12 feet 6 inches above the grade level, and space for seven 100-horsepower units is provided, three batteries on the west and four on the east side of the building, only the three batteries on the west side being set at the present time. A 3,000-horsepower heater and two 14x9½x12-foot feed pumps are located in the north end of the boiler room. Directly above this, in the center, 20 feet above the boiler-room floor, is located a water tank of 20,000 gallons capacity. In the southwest corner of the boiler room the smoke stack is located. This stack is 49 feet high, supported on the roof of the building, being connected with a breeching at the back ends of the boilers. The breeching and stack at their intersection are equipped with a 7x16-foot diameter blower belted to an electric motor for mechanical draft.

*Reprinted by courtesy of California Journal of Technology.

A covered pipe trench 9 feet wide and 8 feet deep runs the entire length in center of boiler room, in which the intake pipes conduct the water from the Duwamish River to the condensers on the south side of the engine room. At right angles to this pipe trench, in the north end of the boiler room, is a tunnel which discharges the water back again to the river. The length of this tunnel is about 300 feet, the sectional area being of sufficient capacity for the total contemplated number of units when completed.

The structure was originally designed with a structural steel frame and brick curtain walls. At the time proposals for its erection were received, it was found that deliveries for structural steel could not be guaranteed in less than five months from signing of contract. Principally for this reason it was decided to change the construction to reinforced concrete; but in addition to slow delivery for structural steel, a scarcity of skilled mechanics and the high price of such labor was a further incentive to making the change.

The ground on which the structure is built is sand. There are 1712 piles in the foundations, average length 25 feet. While the sand was compact enough to support the necessary loads, it was not considered wise to assume that the areas between the river bank and the structure might never be disturbed by the flow of the river.

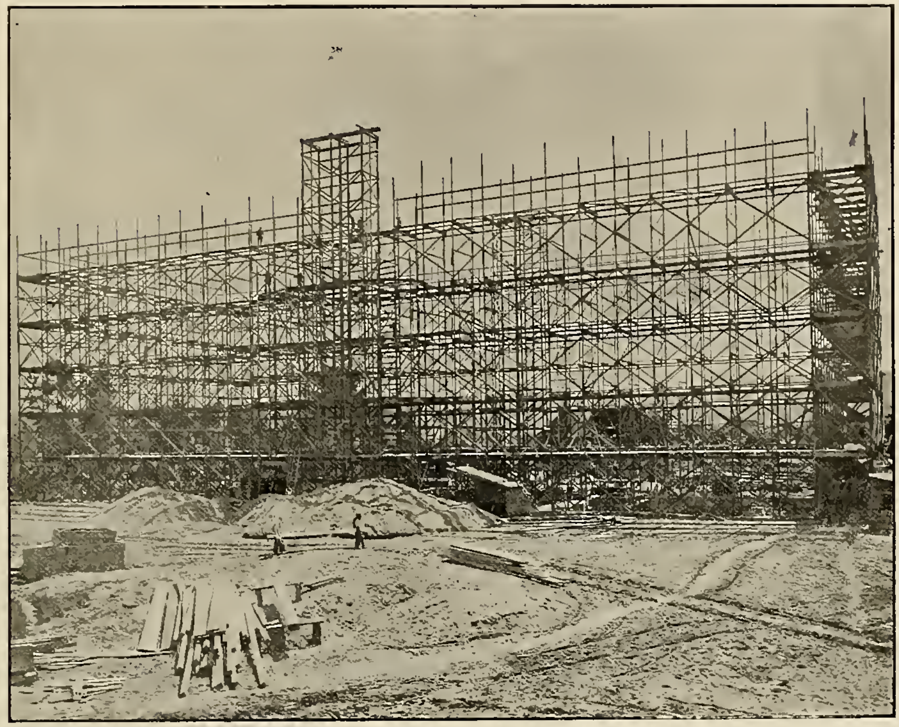
Like most of the work undertaken by Frank B. Gilbreth, speed was of utmost importance, and it was desirable to begin driving piles directly after the contract was signed. On account of this, approximate calculations of the loads were made before designs for the reinforced concrete construction were gotten out.

While in the construction of a building, work must begin at the foundations, just the reverse of this is done in the design, since working drawings for the foundations cannot be gotten under way until the entire design for the structure is complete.

Some time before pile driving was finished, working drawings for the foundations were completed and sent to the work, and this kept a large force of men at work on the structure while working drawings for the super-structure were in progress.

Due to the high price of broken stone, washed gravel was used for the aggregate, with the exception of some portions of the foundation and the wide-span girders in the engine-room roof. An imported Portland cement was used, the proportions generally being 1:2:4, except the wide-span girders, which were 1:2½:3.

With the exception of some corrugated bars, which were purchased from stock near the work, all the reinforcement consisted of round rods. Practically the entire amount was cut to schedule and shipped from Pittsburg direct to the work.



SHOWING STAGING WHICH WAS ERECTED IN ADVANCE OF THE STRUCTURE, WHILE WORKING DRAWINGS WERE BEING PREPARED AND MATERIALS WERE ON THE WAY TO THE SITE. HOISTING TOWERS ON EACH SIDE OF THE BUILDING ARE SHOWN. THESE HOISTS WERE USED FOR FORMS, REINFORCEMENTS AND CONCRETE.

To insure delivery within the time promised, a man familiar with long-distance freight shipments was sent to the mills, who, after personally seeing the material loaded on cars, remained with them until they reached their last transfer point. In this way the movement of cars all along the route was known, and possible delays, due to accidents and cars being temporarily side-tracked, were avoided.

Due to the absence of intermediate floors in the structure, it was found advisable to erect a staging entirely around it, the full heighth of, but just clear of the outside walls. From this staging, all forms for walls were built and the concreting done, runways within the staging connecting with the hoists at levels about every 12 inches in height being provided. This staging remained in position until after the walls had all forms removed and cleaned down. The erection of this staging progressed while the working drawings were being gotten out and while shipments of the steel reinforcement were on the way from Pittsburg.

Points of interest in the design to which special attention might be called are in connection with the 64-inch span girders supporting the engine-room roof. On account of their position in the structure in connection with the monitor which they support, only a rectangular section could be considered. So far as the writer is aware, these girders are the longest

span of any ever constructed whose section, at the point where maximum bending moment occurs, is rectangular. The assumed live load was taken at 30 pounds per square foot. The reinforcement consisted of 12—1¼-inch round rods, 8 in the bottom and 4 at the top, the bottom rods being bent up at the ends. The ends of these rods were threaded and rigidly secured to anchor plates by lock-nuts. In addition to separators formed with 1¼x1x3/16-inch angles and ¼x2-inch bars, which held the rods in position, vertical stirrups formed with ⅝-inch round rods were used.

The structural-steel design for this roof contemplaed a Warren girder built up with angles and plates. This truss was designed to support I-beam purlins, and a reinforced concrete slab spanning these purlins was intended.

In comparison with the reinforced concrete girders as built, it is interesting to know that, if the same live load is assumed and the depth for the Warren girder is the same depth as the concrete girder, the sectional area of metal (upper chord plus lower chord, including diagonal and vertical members) in the Warren girders per foot of span is practically the same as the sectional area of reinforcement (upper plus lower, plus the stirrups) of the concrete girder.

On the face of it, this statement at first glance would appear contradictory, but consideration of the fact that the upper member of the steel truss necessarily has to be of greater sectional area than the low member, due to its unsupported ½ length being in compression, while the larger portion of the reinforcement in the concrete girder is in the bottom, accounts for this seemingly contradictory statement. While the pound price for the round rod reinforcement would be but 65 per cent of the pound price of the structural steel, and this difference would be enough to pay for the concrete of the girder, the cost of the forms, amounting in this case to about 15 per cent additional, would be the amount the cost of the concrete girder would exceed the Warren girder.

Due to the dead weight of concrete and the limiting stresses to which this material may be subjected, any construction which contemplates wide spans for beams and girders is necessarily at a disadvantage when cost is compared with steel girders, unless such girders are protected in some way to compare favorably with reinforced concrete from a fire-proofing standpoint. In the present instance, the additional 15 per cent which the concrete girders exceeded the cost of the steel trusses would not pay for a satisfactory fireproof protection to the steel, so that in addition to the matter of delivery of structural steel and the advantage of having a homogeneous structure as against one constructed with several kinds of materials, when the two constructions are compared from a fire-proofing and a cost standpoint, the decision is in favor of reinforced concrete.

Concerning wide spans in reinforced concrete beams and girders, their design and construction are matters requiring much experience and good judgment. Investigation of existing wide-span structures as to cost and their success in meeting requirements of rational and safe engineering, will force the truth of this statement on anyone competent to give the subject consideration.

When, as in the present instance, only a rectangular section can be considered, enough reinforcement is used (in a section of a size which, on account of the dead weight of the material, will not be prohibitive) to insure the extreme fibre stress in concrete not exceeding 500 pounds per square inch, the stress in steel is reduced to a value much below 10,000 pounds per square inch, this from a cost standpoint alone will eliminate reinforced concrete from comparison with other materials it seeks to displace.

Even the matter of cost removed from the problem, when a permissible section, due to the excessive amount of steel, has a compressive area much greater than half the section, resulting in low values for steel in tension, and extreme fibre stress of concrete not exceeding 500 pounds per square inch in compression, the proposition becomes steel protected by concrete rather than concrete reinforced by steel. Enough experiments with sections having such large percentages of reinforcement have not been made to warrant our making the usual assumptions regarding beam action, which is permissible when a smaller percentage of reinforcement is used.

On account of these conditions it becomes necessary to consider greater extreme fibre stresses for compression in concrete. Enough reliable experiments have been made to show that concrete can be so proportioned and manipulated to realize an ultimate compressive strength of 2500 pounds per square inch at the age of 30 days, and about 4000 pounds per square inch at the age of 90 days.

While a permissible extreme fibre stress of 1000 pounds per square inch under these conditions would only give a factor of safety of 2.5 at the age of 30 days, it would seem reasonable to permit values approaching that amount when the design and construction are under the supervision of those who make a specialty of that class of work.

While the usual assumptions in regard to flexure and with the ratio of the moduli of elasticity of steel to concrete Es/Ec—15, the resulting stresses for these girders are 900 pounds per square inch extreme fibre-stress compression for concrete and 16,000 pounds per square inch tension for steel.

The maximum bond stress for reinforcement is 80 pounds per square inch, and the maximum sheer for concrete, 95 pounds per square inch, the value of vertical and diagonal sheer members being neglected.

The balance of the structure presents nothing unusual in design, except that all girders, beams and slabs have some reinforcement in their compression parts. The condition of continuity and monolithic action of reinforced concrete has been accepted, and assumptions which are considered rational have been made for all calculations, and reverse stresses due to possible unequal loading or negative moments are taken care of by reinforcement to meet these requirements. Where slabs are reinforced in both directions, the spacing is made to vary as closely as possible with the bending moment.

With the exception of the wide-span girders of engine-room roof, extreme fibre stress for concrete in compression is limited to 550 pounds per square inch, and steel in tension 15,000 pounds per square inch; bond stress in reinforcement not exceeding 75 pounds, and sheer in concrete 60 pounds per square inch.

Any reinforcement over 1 inch in diameter has positive end anchorage with plate washers rigidly secured with lock-nuts, and rods less than 1-inch diameter, except where entering outside walls and columns, are bent at right angles 3 inches from the ends.

Unit stresses in comparison for columns, due to direct and eccentric loading, are quite low, the maximum not exceeding 600 pounds and the minimum being as low as 190 pounds per square inch. Practical consideration in regard to these sections rather than limiting unit values for concrete in compression, determined their size.

In addition to stresses caused by static and moving loads, stresses as the result of vibrations due to possible seismic disturbances were constantly kept in mind, and all joints and connections were designed to meet these requirements.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

ASBESTOS.

"Ebony or Impregnated Asbestos Wood." This material possesses all the qualities of "Plain and Oak Asbestos Wood," but is better in non-absorption and dielectric properties. Approved for limited use, with suggestions for more extensive application, March 19, 1908. Manufactured by

Asbestos Wood Company, Nashua, N. Y.

GROUND CLAMPS.

"Bulldog" clamp for rigid conduit. A ½-inch copper strap with clamping screw forming lug for soldered connection to ground wire. Approved March 16, 1908. Manufactured by

Fairmount Electric Mfg. Co., 2322 Market Street, Philadelphia, Pa.

RECEPTACLES, WEATHERPROOF.

Cat. No. 9408, 3 A, 250 V. Approved February 27, 1908. Manufactured by

H. T. Paiste Co., 32d. and Arch Streets, Philadelphia, Pa.

RHEOSTATS.

C. H. Motor Speed Regulators, Bulletins 40, 41, 42, 43, 44, 44½, and 45. Approved March 17, 1908. Manufactured by

Cutler-Hammer Mfg. Co., Twelfth St. and St. Paul Ave., Milwaukee, Wis.

SOCKETS, STANDARD.

Bryant Brass Shell, Key and Keyless Fixture Sockets, "Security Snap," "New Wrinkle." Also above types with shade holders attached. Approved March 17, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SOCKETS, WEATHERPROOF.

"Paiste" Weatherproof Sockets, 3 A, 250 V, pendant style, porcelain shell, Cat. Nos. 9,366, 38,687, and 22,754; composition shell, 60,666. Bracket style, porcelain shell, Cat. Nos. 9,448, 9,496, 45,491, 45,492, 22,755, and 22,756. Approved March 17, 1908. Manufactured by

H. T. Paiste, Thirty-second and Arch Sts., Philadelphia, Pa.

SWITCH BOXES.

Ostrander Switch Boxes for flexible tubing, armored cable, flexible and rigid conduits. Approved March 16, 1908. Manufactured by

W. R. Ostrander Co., 22 Dey St., New York, N. Y.

"Renim" cast-iron boxes. Types A, B, B and E. Cat. Nos. 11 to 15 inclusive, 22 to 26 inclusive, 31, 41 to 46 inclusive, and 51, for knob and tube work. No. 61 for conduit work. Approved March 16, 1908. Manufactured by

Renim Specialty Co., Boston, Mass.

ATTACHMENT PLUG, FUSELESS.

"Benjamin," 3 A, 250 V. Cat. No. 903, with rotating screw shell and outlet bushing or cap holding cord without use of knot. Approved March 2, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Blvd., Chicago, Illinois.

FIXTURES.

"Faries," portable types, equipped with approved reinforced portable cord and separable cap attachment plugs, Cat. Nos. 14, 23, 30, 63, 152, 153, 827, 1012, 1052 and 1842. Approved Mar. 10, 1908. Mfd. by

Faries Manufacturing Co., Decatur, Ill.

Post-Glover Electric and Combination Fixtures. Approved Feb. 26, 1908. Mfd. by

The Post-Glover Electric Co., 314 W. Fourth St., Cincinnati, Ohio.

LAMP GUARDS.

"New Keystone Guard," for portable lamps. A porcelain receptacle mounted in substantial wood handle with heavy cast collar and wire guards. For 16 and 32 C. P. lamps. Approved Mar. 10, 1908. Mfd. by

Electric Service Supplies Co., Keokuk, Iowa.

RECEPTACLES, STANDARD.

Porcelain shell, keyless. 3 A, 250 V. Cleat Type, Cat. Nos. 28794, 28795 and 11221. Concealed, Nos. 50744 and 50717. Conduit Box, Nos. 9397, 40537 and 49354. Sign Receptacles, No. 46627. Wall Sockets, brass shell, key, 50 C. P., keyless, 3 A, 250 V. Concealed base, Nos. 9184, 27742, 29404, 9185, 27743 and 29415. Angle base, Nos. 50753, 28721, 29406, 50755, 28722 and 29407. Approved Mar. 10, 1908. Mfd. by

General Electric Co., Schenectady, N. Y.

RECEPTACLES, WEATHERPROOF.

Combined cleat and receptacle, weatherproof type. Approved Mar. 10, 1908. Mfd. by

Electrical Products Co., Morristown, N. J.

ROSETTES, FUSELESS.

Fielding Rosettes. 3 A, 250 V. Cleat, concealed and moulding types. Cat. Nos. 433 to 438 inclusive, 441 and 480. Approved Feb. 27, 1908. Mfd. by

H. T. Paiste Company, 32nd and Arch Sts., Philadelphia, Pa.

SOCKETS, STANDARD.

Brass shell, key and keyless. Cat. Nos. 9386, 9392, 50-760, 50768, 19386, 19392, 49386, 49392, 99386, 99392, 43389, 43390; and "Security Snap," Cat. Nos. 44147-44152 and 44814. 44815. Also above types with shade holders attached. Approved Feb. 27, 1908. Mfd. by

H. T. Paiste Company, 32nd and Arch Sts., Philadelphia, Pa.

SWITCHES, KNIFE.

Cornell Switches. 0-100 A, 250 and 600 V. Front or back connected, with or without extension for N. E. Code cartridge enclosed fuses, two and three pole. Approved Mar. 10, 1908. Mfd. by

Electric Fittings Co., Trumansburg, N. Y.

Paiste Porcelain Base Baby Knife Switches. 15 and 25 A, 125 and 250 V. Cat. Nos. 501 to 510 inclusive, and 513 to 522 inclusive. Approved Mar. 10, 1908. Mfd. by

H. T. Paiste Company, 32nd and Arch Sts., Philadelphia, Pa.

ATTACHMENT PLUG, FUSELESS.

Perkins Separable Cap, Edison Shell Attachment Plug, 3 A, 250 V. Cat. Nos. 3,284 and 3,530. Approved March 20, 1908. Manufactured by the

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

CABINETS.

Cuthbert panelboard cabinets, lined steel cabinets, and Types A and AA switch boxes and special theater cabinets; wooden cabinets with steel or slate linings; wooden cabinets with asbestos lining for use, except with metal conduit or armored cable. With steel or wooden fronts, with or without glass panels in doors. Approved March 20, 1908. Manufactured by

Cuthbert Electrical Manufacturing Co., 105-109 S. Clinton St., Chicago, Ill.

Steel panelboard cabinets, with or without steel gutters, with or without back wiring compartment. Metal doors, with or without glass panels. Also pressed-steel boxes for service entrance switches. Approved March 20, 1908. Manufactured by

Electric Mfg. Co., 926-940 La Fayette St., New Orleans, La.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

VOL. XX APRIL 11, 1908 No. 15

EDITORIAL.

ENGINEERING SECRECY.

It seems necessary to the life of any fraternity that it possess some secret that is jealously guarded and ofttimes forms the incentive that induces membership from the curious. So with the growth of an engineering brotherhood, and in particular an electrical fraternity, we often find this false idea of secrecy firmly established, but with this difference, that even members are kept in the dark as much as possible respecting the mysteries of the other man's work. By this we refer not so much to the reluctance to impart information that will benefit a competitor, as to withholding the experience-gained knowledge that will prevent some co-worker from repeating the same mistake.

Its motive is supremely selfish and directly antagonistic to the fine conception that man's value to society depends upon the impetus he may have given to the advancement of human progress along whatever direction his abilities best permit. Our debt to our predecessors in the way of crystallized knowledge can be paid to posterity only by adding our own contribution of discovery or production. It is deemed the first duty of everyone to cultivate the mode of expression by which he may best advance his fellow creatures and add to the sum total of knowledge. The artist enriches our lives by his painting, the composer by his music, the sculptor by his statuary, the author by his writing, the orator by the effect of his speech, and the engineer by his achievements.

Each expresses his personality in his own way, in accordance with the faculties that he has most highly developed. The names that endure in the lists of Fame are of those who have furthered human progress. We all can add our small quota, which unbeknownst to ourselves, possibly may be magnified, even as was the widow's mite. To be effective, our work must be evident. A clock without hands, be it running ever so regularly, is not more useless than a worker without expression. If we cannot write, we should talk, that others may write. If we cannot talk nor write, we should use our hands to the best of our ability and thus leave some monument of our endeavors, more lasting than mere riches.

Often has progress been delayed because great minds had to work out problems which had been solved years before. This wasted energy would have been available for greater works if the knowledge of the simpler had been known.

There is no function of history that is more important than that of preventing the re-duplication of effort, and from it the wise man learns by the mistakes of others. If we "hide our light under a bushel," we not only blind ourselves with its little importance, but also compel others to work without its aid, whereas the two combined might soon make clear the way of attack. "My light is none the less for having lit that of my neighbors." The interchange of technical knowledge makes all richer and none poorer, and as a cold business proposition is a good paying investment as is amply testified in the record of all scientific advance. The petty craving for credit has often overreached itself by prematurely causing the demise of the silent worker, whose efforts are thus lost to the world. The loss is the more regrettable because it is the more easily avoidable. Personal gain can or should be insured by patent. This publicity will provoke suggestions of improvement from others, which may again be turned to personal advantage.

Commercial exigencies have caused corporations to put the seal of secrecy on the lips of all their employees, often lessening ambition's spur to do even more. Details as to cost are withheld because of fear of criticism from others in the same field or for fear of smaller margin of sales profit. If publicity were given to these facts, processes would be improved in accordance with the adage that "two heads are better than one," and renewed public confidence would cause greater sales to compensate for smaller profits. The friction of universal secrecy would almost stop the wheels of industry, whereas the mutual exchange of ideas imparts an added moving force which advances both the helper and the helped as a result of the economy of effort and because of the removal of opposition.

THE SHOW IS OFF.

The shortness of time in which to prepare for the San Francisco Electrical Show, scheduled for the week of the eleventh of May, has necessitated calling it off at the eleventh hour. Eastern exhibitors desiring to make a large display could not possibly secure the necessary material in the limited time available, and consequently declined to exhibit. The manifest injustice and discrimination against them has been deemed by the directors sufficient cause for this action. But plans are already being perfected for another and bigger Exposition to be held in October of this year, in which every facility will be afforded for a fitting electrical representation.

PERSONAL.

Mr. T. C. Clifford, representing the Pittsburg Meter Company is on the Coast on official business.

Dow S. Smith, formerly general superintendent of the Brooklyn Rapid Transit Company, is at Spokane, Wash.

Mr. A. Genalein has been appointed manager of the Azusa and Glendora division of the Interstate Gas Co. of California.

Mr. C. F. Hewitt has succeeded Mr. G. C. Pierce as general superintendent of the East St. Louis & Suburban Railway of East St. Louis, Ill.

Mr. G. C. Pierce has resigned as general superintendent of the East St. Louis & Suburban Railway Company of East St. Louis, Ill., and expects to visit San Francisco shortly.

Mr. Bunroku Arakawa, professor of the Engineering College of Tokio Imperial University was in San Francisco last week. After inspecting the single-phase equipment of the Vallejo road he proceeded East.

M. L. St. D. Roylance, electrical engineer and draughtsman, for five years connected with the office of Inspectro of Equipment, U. S. Navy, at the Union Iron Works, San Francisco, California, is now located with the equipment department, Navy Yard, Mare Island, California.

Messrs Seligman & Ljungkfist, Swedish engineers, are on the Coast, investigating long distance, hydro-electric transmission. They visited many plants in Southern and Central California and last week investigated the equipment of the Snow Mountain Power Company. They are now in Seattle.

S. P. Russell, Jr., who recently returned to take charge of the electrical department of H. W. Johns-Manville's San Francisco branch has been seriously ill with inflammatory rheumatism. Last week he suffered a partial stroke of paralysis but has recovered sufficiently to be able to go to the springs to recuperate.

Mr. C. W. Burkett, for the past five years chief engineer of the Wisconsin Telephone Company, with headquarters at Milwaukee, is now chief engineer of the Pacific Telephone and Telegraph Company, with headquarters at San Francisco. This company operates in California, Oregon, Washington, Idaho, Arizona and Nevada.

TRADE CATALOGUES.

"When the Clock Struck One," is the title of a unique folder on lamp guards from Harvey Hubbell, of Bridgeport, Conn.

One of the neatest little advertising devices brought to the attention of the "Journal" this year is a card calendar of the F. Bissell Company, of Toledo, Ohio—"The House with the Stocks." Send for one; it will interest you.

Bulletin No. 4570, recently issued by the General Electric Company, Schenectady, N. Y., describes and illustrates the General Electric Tungsten Lamp for 100 to 125-volt circuits. The lamp is made in 40, 60 and 100 watts, and has a life of approximately 800 hours when used on either alternating or direct current. Some of the illustrations show the tungsten incandescent units combined with standard Holophanes, which can be used to excellent advantage in this manner.

The Habirshaw Wire Company, with offices at 253 Broadway, New York City, send a valuable price list of National Electric Code Standard rubber-covered wires and cables for voltages up to 600, inclusive; also for such telephone wires and special cables as have been standardized. This price list is detailed from all sizes of wire on a copper basis of 12 to 25 cents, inclusive, and also includes a rubber factor. Its completeness and conciseness makes it invaluable.

H. Mueller Mfg. Co., of Decatur, Ill., send a leather-bound, loose-leaf catalogue of all their products that forms one of the best reference and ordering books yet received. In it is listed all possible devices and connections used by water, gas and plumbing interests, arranged for rapid and systematic finding. The descriptions are concise and complete, and well illustrated. The volume contains nearly 900 pages, and is arranged for facile addition of new sheets as new goods are made. The typographic and mechanical excellence of the book recommends the goods catalogued.

Graded shunt resistance multigap lightning arresters for 1908 are described in a new bulletin issued by the General Electric Company at Schenectady, N. Y., and numbered 4573. The bulletin also contains detailed descriptions of low voltage arresters, static dischargers, constant-current horn arresters, disconnecting switches, choke coils and the well-known Type M, Form D-2, direct-current arrester for voltages up to 6000. Tables of general data regarding the apparatus, connection and dimension diagrams, etc., are included. The multigap arresters for high voltages consist essentially of a series of knurled cylinders placed closely together, the discharge taking place across the path of gaps thereby produced and being extinguished before the dynamic current can follow it for more than half a cycle by reason of the peculiar composition of the metal making up the cylinders.

WESTINGHOUSE MACHINE CO. RECEIVERS REMOVED.

I have much pleasure in being able to notify the clients and other friends of the Westinghouse Machine Company that the Receivers appointed October 23, 1907, by the Circuit Court of the United States for the Western District of Pennsylvania, were on March 31, 1908, discharged by the same authority. All of the matters which made a temporary receivership expedient have been satisfactorily arranged, and the Company's position is greatly strengthened from every standpoint.

All contracts made by the Receivers for the sale of the Company's product, or for the purchase of materials or merchandise will be carried out as though made by the Company's own officers.

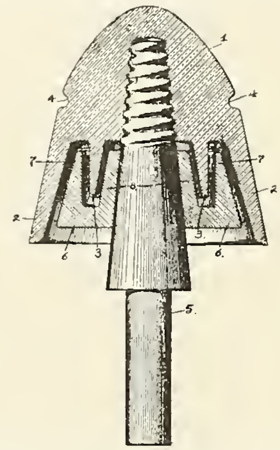
I take this occasion to announce the election of Mr. William H. Donner as the Vice President of the Company in direct responsible charge of all its activities, and to give the assurance of the continuance and accentuation under Mr. Donner's administration of that steadfast policy whereby the clients of The Westinghouse Machine Company have become friends as well as customers.

Geo. Westinghouse, President.

PATENTS

INSULATOR. 882,803. Leonard W. Storror, San Francisco, Cal.

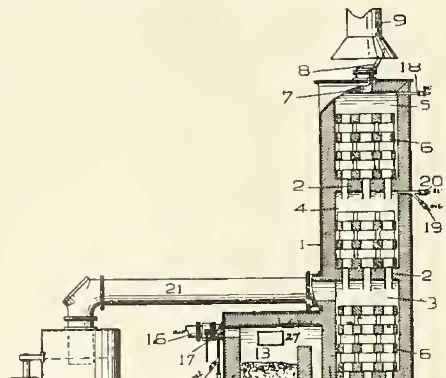
In an insulator, a pin having its top frusto-conical and threaded for a part of the length of said frusto-conical top, a protecting member made of an insulating material and adapted to fit tightly on the frusto-conical part of the pin for the entire depth of the said protecting member, said



member also having an upwardly projecting flange whose outer surface is a portion of a cone, and a wire-carrying insulating member having internal threads adapted to fit the threads of the pin, said wire-carrying member having a skirt adapted to project down into the space between the flange on the protecting member, said wire-carrying member also having an outer skirt extending below the bottom of the protecting member.

PROCESS OF MAKING GAS. 882,764. Leon P. Lowe, San Francisco, Cal.

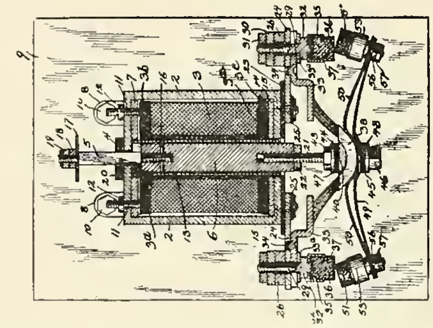
The process of manufacturing gas which consists in passing products of combustion of oil and air entirely through a chamber containing loosely-piled refractory material, to highly heat said refractory material then excluding the air and passing



the oil partly through the chamber and the refractory material therein in the same direction as in the heating stage, and simultaneously passing in the opposite direction steam through part of the refractory material to superheat the same, and oil commingled with the steam so superheated through refractory material in the chamber and drawing off the generated gases together.

ELECTRICALLY-OPERATED SWITCH. 883,059. Henry F. Starrett, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

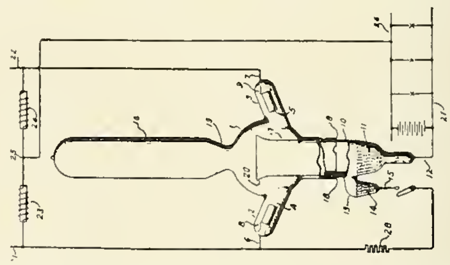
In an electrically-operated switch, the combination with a frame adapted to contain a magnet coil and surround said coil upon its sides and ends, of a supporting plate secured to



the upper part of said frame, outwardly-turned lugs formed upon said plate, a suitable base to which said lugs are adapted to be secured, insulated bridging plates secured to the lower part of said frame, contact plates secured to said bridging plates and electrically conductive posts mounted on said base and secured to said bridging plates, to support said frame.

VAPOR ELECTRIC APPARATUS. 883,030. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company.

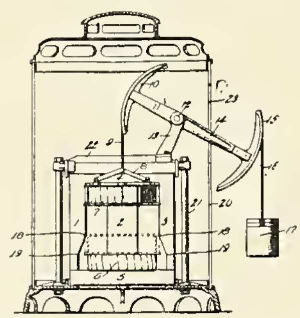
In a vapor electric apparatus, the combination of an envelope or receptacle having a plurality of projecting arms



or chambers, electrodes in said arms or chambers, a vaporizable electrode located also in said envelope, and means for causing the arc of discharge from said vaporizable electrode to be projected past the openings into said arms or chambers.

ALTERNATING - CURRENT REGULATOR. 883,007. Augustine R. Everest, Rugby, England, assignor to General Electric Company.

In a constant-current transformer, the combination of a primary winding, a secondary winding, means for allowing the said windings to move away from each other upon in-



crease in current and to approach each other upon decrease in current in the secondary winding, and means for varying the mean length of the air gap in the path of the leakage flux between said windings as said windings change their relative position.

INDUSTRIAL

NEW ALLIS-CHALMERS ALTERNATOR FOR THE NEVADA-CALIFORNIA POWER COMPANY, GOLDFIELD, NEV.

The Nevada-California Power Company, formerly the Nevada Power, Mining & Milling Company, Goldfield, Nev., is preparing to install a fourth Allis-Chalmers alternating current generator, of the water wheel type, having 1500 kilowatt rated capacity, to augment the enlarged power service, now contracted for in the vicinity, pending the completion of their new hydro-electric stations on Bishop Creek, Inyo County, California.

The unit is a 3 phase, 60 cycle, 2200 volt machine, to run at 400 revolutions per minute, and is arranged for direct connection to a water wheel operating under an 850-foot head, alongside of three similar units already installed and similarly driven, the last of which was placed in service in 1905.

These generators are of the standard Allis-Chalmers water-wheel type, with two bearings and extended shaft. The stationary armatures of the machines are of the usual construction, with box frame, self supporting yoke. The rotor spider is specially strong in order to stand abnormal water-wheel speed in case the governor should fail to work. The spider is a solid steel casting, and the pole pieces are securely held by dovetail projections. The field windings are of copper strip wound on edge and designed for 120 volt excitation.

Current from these generators is transmitted 113 miles at 60,000 volts to Tonopah and Goldfield, Nevada, with branches from this line to other points, and supplies power to a number of the mines in that district whose equipment is electrically operated. The following are a few of the properties in Tonopah and Goldfield which have installed Allis-Chalmers Induction Motors ranging in size from 5 to 100 horse-power, and are supplied from the Nevada-California Power Company's mains:

Goldfield Consolidated Mines Co., Goldfield Milling & Mfg. Co., Nevada-Goldfield & Reduction Co., and Montana-Tonopah Mining Co. The latter company has installed fifteen motors, aggregating 600 horse-power.

With the completion of its two stations, the Nevada-California Power Co. will possess hydro-electric power facilities unequalled in this section, as there are two plants already in operation, and the combined capacity will be 14,000 horse-power. Much additional power can also be developed, as the company controls 3200 feet of fall on Bishop Creek, and large storage reservoirs can be built on the headwaters of the stream at no great cost.

CUTLER-HAMMER COMPANY.

The contract for the electric turret-turning gear of the U. S. S. Delaware, now under construction at Newport News, has been awarded to the Cutler-Hammer Mfg. Co., of Milwaukee.

This company designed and built the electric turret turning gear installed in the port, after turret of the Indiana, the crew of which holds the world's record for marksmanship—ten shots in two-and-a-half minutes, all hits.

Every modern war vessel is equipped with a complete electrical plant, the specifications of some of the newer battleships calling for generators having a combined output of 800 kilowatts.

In addition to illumination, wireless telegraphy and interior signal systems, electricity is used on ship board in connection with the refrigerating plant, ventilating fans, forced-draft blowers, and for operating ammunition hoists, boat cranes, deck winches, etc.

WESTINGHOUSE TYPE E ELECTROLYTIC LIGHTNING ARRESTERS.

As the result of experiments covering a number of years, the Westinghouse Electric & Mfg. Company has developed an electrolytic lightning arrester consisting of a number of aluminum plates pressed into tray form so that when set one within the other, separated by small insulating washers, they may be built into a column capable of withstanding high voltages and still retain the safety valve characteristics of a single plate. These columns are made in two sizes, one for voltages between 4000 and 7500, the other for voltages between 7500 and 15,000. The columns are enclosed in substantial stoneware jars. The jars may be mounted one upon the other to form arresters for any desired voltage. A gap on the line side of the electrolytic elements, which will withstand the normal voltage of the system, breaks down with over-voltage and permits the surge to discharge through the electrolytic units.

The electrolyte is dissolved in pure water and poured into the top of the arrester unit. It thus fills the first tray and runs over into the second and so on through the column, the surplus escaping through a hole in the bottom of the containing jar through the next jar, if there be more than one, to the pan at the bottom.

The electrolyte fills only the trays and not the jar, so there is no opportunity for the current to pass except from tray to tray. Each unit when placed in the pan or on another unit automatically makes contact.

The electrolytic solution causes a very thin film to form on the aluminum plates. This film has an apparent resistance of very high value when moderate voltages are impressed upon it, but when the voltage reaches a certain value, it breaks down in myriads of minute punctures, making almost a short circuit. As soon, however, as the voltage is reduced again, the punctures seal up at once and the original high resistance reasserts itself. These arresters are arranged for installation either indoors or out, as suits the convenience of the user.

ELECTRICAL EQUIPMENT FOR COMPANHIA DOCAS DE SANTOS (SANTOS DOCK CO.) BRAZIL.

The Companhia Docas de Santos (Santos Dock Co.), through whose docks most of the coffee exported from Brazil passes, has recently placed a large order with the General Electric Company for complete electrical equipment of their sub-station and docks at Santos. The order is comprehensive and includes six 3000-kilowatt, water cooled, three phase, 60 cycle, 40,000-6600 volt transformers, twenty-three panel switchboard and the necessary cables and wiring supplies. The order also includes five fifty-light constant current transformers, 208 series arc lamps, 420 multiple arc lamps, a large number of induction motors for operating air compressors, hoists, cranes, etc., and a large number of type H oil cooled transformers.

Besides furnishing power for the docks, the sub-station will also supply energy for light and power to various other enterprises thereabout.

Power is supplied at a line potential of 40,000 volts by a hydro-electric plant some thirty-five miles from Santos, the equipment of which was furnished by the General Electric Company two years ago.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on April 15, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of engineer (with knowledge of ice machinery, pumping, and electrical plants), $900 per annum, Indian Service, Colorado River Agency, Ariz., and vacancies as they may occur in the Indian Service in the positions indicated below.

An examination will be held on May 6-7, 1908, to secure eligibles from which to make certification to fill two vacancies in the position of chief engineer, third class, $115 per month each, in the Coast and Geodetic Survey, for service in the Philippines, and vacancies requiring similar qualifications as they may occur in the Coast and Geodetic Survey. The Department states that the appointees to the specific positions mentioned will, upon their arrival at Manila, be promoted to the position of chief engineer, first class, at $140 per month.

Each applicant must submit with his application a license from the United States Local Inspectors of Steam Vessels as chief engineer for ocean 500 tons, or a certificate from the Steamboat-Inspection Service that he has such license.

The United States Civil Service Commission announces an examination on May 6-7, 1908, to secure eligibles from which to make certification to fill from ten to twenty vacancies in the position of junior engineer in the Technologic Branch of the Geological Survey, at salaries ranging from $1,020 to $1,380 per annum, and vacancies requiring similar qualifications as they may occur. Temporary appointments to the position of engineering aid or apprentice may also be made from the eligible list resulting from this examination, at salaries ranging from $720 to $960 per annum. The examination will consist of the following subjects: Elementary chemistry, physics, and mathematics. Essay of not less than 500 words on one of the following subjects (both English composition and drawing will be rated on this subject): (a) On a mechanical engineering subject, accompanied by drawings; (b) on a civil engineering subject, accompanied by drawings; (c) on a mining engineering subject, accompanied by drawings. Mechanics and dynamics of engineering. Engineering special subjects: (a) Testing of structural materials, with outline of necessary observations and computations; (b) testing of fuels, with outline of observations and necessary computations; (c) mining operations, including tunneling, blasting, hoisting, ventilation, shaft sinking, etc. (Ten questions will be given under each subject). Not more than one subject may be taken by any applicant. Training and experience (rated on application form). The vacancies to be filled in the junior engineer grade are in three distinct lines of employment: (1) For testing structural materials, for which an educational groundwork corresponding to the degree of civil engineer or B. S. in civil engineering should qualify the applicant; (2) for testing fuels, for which an educational groundwork corresponding to the degree of mechanical engineer or B. S. in mechanical engineering should qualify the applicant; and (3) for the investigation in the field of methods of mining and production of fuels and structural materials and related subjects, for which an educational groundwork corresponding to the degree of mining engineer or B. S. in mining and engineering should qualify the applicant.

The United States Civil Service Commission announces an examination on May 6, 1908, to secure eligibles from which to make certification to fill vacancies as they may occur in the position of apprentice in the Mint and Assay Service at Philadelphia, Pa., New Orleans, L. A., Denver, Colo., and San Francisco, Cal., at salary as follows: First year $3.50, second year $4, and third year $4.50 per diem.

An examination will be held on April 29, 1908, to secure eligibles from which to make certification to fill at least three vacancies in the position of magnetic observer (temporary) in the Coast and Geodetic Survey, and vacancies requiring similar qualifications as they may occur. The salaries will range from $60 to $75 a month, according to the character of the work and the qualifications of the applicant; and in exceptional cases where the person employed has had repeated experience in magnetic work, the salary may reach $100 a month. Appointments to permanent positions are made from the examination for laboratory assistant in the Bureau of Standards. In the prosecution of the general magnetic survey of the United States and outlying territories, it will be necessary at times, and especially during the summer months, to employ temporarily and for short periods a number of men of the requisite scientific training. Applicants must, therefore, state distinctly in their applications their periods of availability. The time when and the place where such persons are to be employed can not be definitely stated. Persons are desired who have had experience in a university or college as professor, assistant professor, teacher, or tutor in physics or allied sciences; or persons who have taken post-graduate degrees in physics or allied sciences; or students who have had not less than two years' work in physics or allied sciences, including laboratory practice.

As a means of increasing the efficiency of plug and pin bonds the Chase-Shawmut Company, of Newburyport, Mass., presents the Shawmut Auxiliary Bond, a copper cap with rail engaging flange filled with solder, heated and applied to end of bond, and thus by giving additional contact surface reduces to a minimum the resistance at the rail joint. A recent test made with auxiliary bonds applied on new plug bonds just installed showed that an improvement of over 15 per cent in conductivity resulted. With a bond 15 per cent better than a new plug bond and having the advantage of a permanent metallic union, as contrasted with an uncertain pressure contact, the Chase-Shawmut Company believes that all railroad men will appreciate this means towards cost reduction.

Among the orders recently received by the General Electric Company are the following: Three hundred 4-motor equipments for the Chicago Railway Co.; three 1000 kilowatt, 2300 volt, 3-phase alternators for the Manchurian Railway, Korea; twenty-five GE-202, 600 volt, 2 motor equipments, and forty type H oil cooled transformers for the Sao Paulo Light & Power Co., Sao Paulo, Brazil. A shipment of two 50-kilowatt, cross compound marine sets, together with switchboards and necessary instruments, has been made to Olongapo, P. I. These will be used in the U. S. Government drydock Dewey, which recently made the trip around Cape Horn.

The rapid advance of the Dossert Solderless Connectors in the trade is shown by the steady increase in orders received for these remarkably efficient labor saving devices. Among recent orders received by Dossert & Company, 242 West 41st Street, New York, are third rail clasp connectors for 1,000,000 C. M., cable from the New York Central & Hudson River R. R. Co., cable taps 400,000 C. M., main to 0000 bleeder from the Chicago City Railway Co., and cable taps for 1,000,000 C. M., cable from the Syracuse & South Bay Electric Ry. Co.

Dossert & Company, 242 West 41st Street, New York, have received an order for 400 solderless cable connectors from the San Francisco Gas & Electric Company. F. A. Lawson & Company, Pacific Coast agents, write that Dossert solderless connectors have been specified in the plans for the wiring of the new Palace Hotel and Emporium Building, San Francisco.

NEWS NOTES

ELECTRIC RAILWAYS.

Spokane, Wash.—Col. A. M. Dewey, of Spokane, is projecting an electric railway from Spokane to Omak, Okanogan County, Wash., to connect with the proposed Okanogan Electric Railway, thus shortening the distance between Spokane and the Puget Sound country and the Canadian Northwest by 100 miles.

Harry J. Neely, of Spokane, is heading a campaign by residents of opportunity in the Spokane Valley to secure another car line from Spokane. It is proposed by the committee in charge to offer to do a greater part of the grading, and if neither of the traction lines in Spokane can be induced to build, then a gas motor company will be organized to handle the tonnage.

An assignment of franchises, rights and privileges in Spokane and Hillyard to the Spokane & Inland Empire Railroad Company has been filed with the city clerk by the Spokane Traction Company. This is the final step in turning over the titles of the Traction Company to the Spokane & Inland. All the city lines of the former company were assigned to the latter by Jay P. Graves and William G. Davidson, president and secretary respectively of the Spokane Traction Company. The Spokane & Inland has been in practical control of the Traction Company interests since last Fall, when a reorganization of the electric lines, by which all were amalgamated and stock issued to the shareholders of each in the new company, was effected. The Spokane Traction Company has now legally ceased to exist as a separate corporation.

Announcement has been officially made that the Power Development Company, a subsidiary corporation of the Spokane & Inland Electric Railway Company, and one of the corporations belonging to the Inland Empire system, will have a surplus of from 10,000 to 15,000 horsepower from the power station at Nine Mile bridge as soon as the plant is completed, after supplying electric power to the railway lines of the system. It is purposed to utilize this power by supplying light and power to the citizens of Spokane under the franchise bought by Jay P. Graves, president of the system, and associate from Frank P. Hogan. This franchise was granted by the City Council five years ago to a company organized to develop the power down the river at the rapids known as the Bowl and Pitcher. It was for 50 years, and was subsequently acquired by Frank P. Hogan, who also secured the water rights at the Bowl and Pitcher rapids. These water rights passed with the franchise to Mr. Graves of the Inland Empire system, who afterwards transferred them to the company of which he is the head.

Julius Muhrbeck, superintendent of construction of the Spokane & Inland Empire electric system, announces that the laying of steel rails between Palouse, Wash., and Moscow, Ida., will begin at once. The grading between the two points was practically completed last Fall, and it is believed that trains will be running into Moscow early in August. There are also persistent rumors that the line will be extended to Lewiston, Ida., this year. The company has been petitioned by farmers and ranchers in Whitman County to extend the line from Steptoe to St. John. George P. Howard, a prominent farmer at Pleasant Valley, has made a canvass of the farmers along the route of the proposed extension, and without exception they have agreed to donate the necessary right of way, and a number of them have expressed a willingness to take stock in the road. From the junction at Steptoe to St. John the valley through which the road will run is an immense wheat field. If this part of the road is secured an endeavor will be made to have it continued to Cheney by Rock Lake, crossing the main line of the Northern Pacific in the vicinity of Tyler, 12 miles east of Sprague.

TRANSPORTATION.

Riverside.—Teams and men have commenced work on grading for the Riverside-Colton trolley line.

Los Angeles.—Only one offer was made when the City Council received bids for purchase of the street car franchise for the South Park Avenue line from 30th Street to Slauson Avenue. The L. A. Railway Company, which operated the line until it was recently disposed by the Supreme Court, offered $500, which was accepted.

San Francisco.—General Manager Charles N. Black, of the United Railroads, has returned from his inspection trip over the lines of the Northern Electric Company, and he declares that his trip over the road was only for personal reasons, and incidentally to accommodate Eastern friends, who had asked him for a general opinion about the property of the electric road.

San Francisco.—The consideration of a 7-year franchise to the Presidio and Ferries Railway Company to install an overhead trolley service over six blocks, starting at Union Street and via Larkin, Vallejo and Franklin Streets back to Union, was postponed by the Public Utilities Committee of the Board of Supervisors for one week, to give the residents of the district affected an opportunity to express their wishes.

Los Angeles.—The real battle for the beach passenger traffic was begun between Harriman and Huntington, when the former started the operation of the fastest cars ever brought to California over his Los Angeles-Pacific system, just standard-gauged and reconstructed throughout. Heretofore, the Harriman lines, with antiquated coaches and inadequate equipment, have not cut materially into Huntington's business; but now his Los Angeles and Redondo line will be directly affected. Work was rushed at a remarkable rate on the Harriman system, and it was completed three weeks in advance of the time scheduled. The new cars, which are to be run in trains of three, are olive green, and have several features that are innovations in trolley service. In addition to the side entrances there are wide swinging doors in the center at either end, making an open passage from coach to coach, and a practically vestibuled train. The motor box and automatic brake are located in a right-hand corner of the car, and the headlight is attached to the center door. Each car seats 58 passengers, and is capable of making 60 miles an hour.

WATER WORKS.

Rawhide, Nev.—Contracts are being advertised to install waterworks from wells below town. The water system is assured, as $100,000 has been subscribed.

Georgetown, Cal.—Norval Douglas has filed a notice of appropriation of 5,000 inches of the water flowing in Travis Creek below the junction of Bear Creek, to run machinery to generate electricity.

Chihuahua, Mex.—Gov. Creel gave out the information that a commission, headed by Thos. S. Shepard and the City Engineer, has been named, to study plans for extending the water and sewer systems of this capital. Gov. Creel states that a large tank will be placed at the new penitentiary, to provide water for that part of the city above Chihuahua and Pacific depot.

TELEPHONES.

Hood River, Ore.—The farmers of the West Side have organized the Farmers' Telephone Company.

Hermiston, Ore.—The Eastern Oregon Telephone Company is rushing work on the new telephone exchange.

Chehalis, Wash.—E. A. Marsh has made application to the City Council for a franchise to construct a local telephone system.

Index, Wash.—A telephone line is being erected between the Sunset mining camp and Camp Ecki, to connect with the Index system.

Roseberry, Idaho.—The Long Valley Telephone Company has filed articles of incorporation. This was formerly the Mutual line.

Prosser, Wash.—An ordinance has been passed by the City Council granting the Benton Independent Telephone Company a franchise.

Whitefish, Mont.—Carl Green has the poles on the ground for his new telephone system, and will lose no time in getting the plant in operation.

Davenport, Wash.—By agreement the Farmers' Telephone Company will build lines to the city limits and there connect with the city system.

Anatone, Wash.—The Farmers' Mutual Telephone Company lately met in Clemans' Hall to perfect plans for running a line from Anatone to Asotin.

Independence, Ore.—The Home Telephone Company has been organized. A modern telephone plant will be built, known as the common battery system.

Antone, Wash.—Bids are being received by G. E. Zimmerman, secretary Antone Farmers' Mutual Telephone Company, for the construction of a telephone line from Antone to Asotin.

Kirkland, Wash.—Jas. Bell, manager of the Lake Washington Telephone Company, went to Bothell lately to canvass the residents of that vicinity in the interests of extending the line to that town.

Miles City, Mont.—Reports are out of the organization of a telephone company to conduct a line from Miles City to Forsyth. Kent McLean, Major Edwards and others are interested in the project.

Miles City, Mont.—F. C. and E. A. Hughes of the electric light firm of Glendive were in the city recently conferring with local people relative to the construction of a toll telephone line between this place and Glendive.

Eugene, Ore.—The Pacific States Telephone & Telegraph Company has appropriated $20,000 for improvements to its system here this summer, and an engineer is now mapping out the work, which will begin within a few weeks.

Seattle, Wash.—The county commissioners have lately heard A. W. Davis of Redondo Beach and Secretary Hickey of the Sound Trustee Company on the petition of Davis for a franchise covering the streets of Redondo Beach. The board has taken the matter under advisement.

Centralia, Wash.—Eugene A. Marsh of Portland presented his application to the City Council for a franchise to establish a telephone system in the city. B. E. Clements, also of Portland, has a franchise for a telephone system in the city, and has until April 1st to begin construction.

Weston, Ore.—A plan is on foot for an independent telephone system requiring 20 miles of wire to connect Weston with the Blue Mountain sawmill, Bingham Springs, W. J. Furnish's Summer home on the Umatilla River, and the permanent camp of the government forest rangers at the forks of this stream.

Wenatchee, Wash.—The ranchers of Stemilt Hill met and organized a telephone company, to be known as the Stemilt Hill Telephone & Telegraph Company. O. Allenbaugh was elected president; Dan Chisolm, vice-president; W. McPherson, secretary, and Henry Wills, treasurer. The company will build its line so as to connect with the Farmers' Telephone Company, whose headquarters are here.

Hailey, Idaho.—The National Forest Service will spend considerable money in this section. The bulk of $17,000 which is for expenditure will be expended in the Wood River watershed. The most important of this work will be the construction of a telephone line from Ketchum, the present terminus of the Rocky Mountain Bell Company, to Stanley Basin, thence down the Salmon to Robinson Bar—about 90 miles. This line will follow the main road to Robinson's, on the Salmon River, and afford a means of communication between all the mines and ranches within 30 or 50 miles of the line to Wood River, as every facility to build connecting lines is to be afforded those who desire it. From Galena an extension will be made west 25 miles to Atlanta, that is, just within the boundary of the Sawtooth West National Forest.

POWER AND LIGHT.

Spokane, Wash.—Official announcement is made that $1,000,000 of the $3,000,000 realized by the Washington Water Power Company, of Spokane, from the sale of an issue of 5 per cent notes, will be used in extending its power line in the big Bend country, tapping the towns of Davenport, Sprague, Ritzville, Paha and Lind, Wash. The other $2,000,000 will be devoted to refunding an issue of $2,000,000 of 5 per cent notes maturing July 1, 1908. It is given out that the steam relay station at Ross Park, Spokane, will be increased to 16,000 horsepower from 4,000 horsepower, and that the waterpower plant at Post Falls, Ida., will be increased from 12,000 to 15,000 horsepower. This means that by next August the company will have 44,000 horsepower, or an increase of 15,000 horsepower at present. The company already has two high-power lines running east to the Coeur d'Alenes, and another south to Colfax, Palouse and Oakesdale. R. Lewis Rutter, secretary of the Spokane & Eastern Trust Company, which placed the paper in New York, Boston, Philadelphia and Chicago, says the issue was subscribed in less than 20 days, and that several of the largest financial houses in the country bought blocks of from $100,000 to $200,000. Orders came from every part of the country, and more than $100,000 could not be filled because of over-subscription. He added that this is probably the most remarkable flotation of securities ever made by a Northwestern corporation.

FINANCIAL.

Lodi.—May 5th has been decided upon as the time to vote on the proposed bond issue of $126,000 for water, light and sewer systems.

Los Angeles.—The Southern Trust Company has subscribed to $25,000 worth of Owens River bonds. City Treasurer Hance says that the entire allotment of $510,000 will be disposed of by the last of next week.

Salinas.—The Gonzales Electric Company has been incorporated with a capital stock of $75,000, by H. M. Pitman, of Calistoga; M. C. Clark, of Gonzales, and E. Johnson, of Oakland. The place of business is Gonzales.

Vallejo.—At the last meeting of the Board of City Trustees, April 16th next was set as the date for the bond election, when an issue of $85,000 to build a second reservoir for the municipal system in Wild Horse Valley will be determined.

Petaluma.—The comparative statement of earnings for the month of February of the Petaluma & Santa Rosa Railway Company is as follows: Gross earnings, 1908, $13,903.52; 1907, $12,837.48; operating expenses, taxes, etc., 1908, $13,205.40; 1907, $12,087.54; net earnings 1908, $698.12; 1907, $749.94.

Honolulu.—At the annual meeting of the stockholders of the Hawaiian Electric Company, Ltd., February 29th, the following officers were elected: President, J. A. McCandless; vice-president, F. W. Macfarlane; treasurer, F. C. Atherton; auditor, Godfrey Brown; secretary, W. L. Hopper. The above also constitutes the board of directors.

Lodi, Cal.—At the last meeting of the city trustees the proposed bond issue was considered. For the sewer system the plans call for an expenditure of $50,000, and for light, power and water system $76,000, making a total bond issue of $125,000. The date of election, the interest on the bonds and the time they should run will be fixed at the next regular meeting on April 6th.

San Francisco.—A mortgage and deed of trust, executed by the Pacific Gas & Electric Company to the Trust Company of America to secure the latter in guaranteeing a bond issue of $4,000,000 by the lighting corporation, has been filed in the recorder's office. The mortgage covers all of the real and personal properties of the gas company. The bonds are to run for 30 years, and bear 6 per cent interest.

San Francisco.—The Pacific Gas & Electric Bonds Company has deposited with the Union Trust Company $250,000, and will ask offerings from the bondholders for the redemption of bonds to that amount, out of which the lowest offerings will be accepted. This company calls each year for the redemption of its bonds, as provided by the sinking fund. The redemption will take place on April 7th.

Oakland, Cal.—Water rates for the coming fiscal year will be reduced not less than five per cent, with a probability that a cut of ten per cent in private consumers' rates will be effected by the city council. This forecast is based upon the existence of an agreement between the People's Water Company and the city council under which the company last year stipulated that a cut of not less than five per cent would be made voluntarily for the year 1908-9.

New York.—No public offering of new issue of the United Railways Investment Company will be made. It will be used for refunding directly the floating obligations of the United Railroads of San Francisco, and in case any of the creditors of the San Francisco line do not care to accept the new notes in discharge of the indebtedness, plans are being formulated to place a part of the notes privately, so as to secure sufficient cash to pay off those who want a money payment.

Santa Barbara.—The failure to dispose of $36,000 remaining of the old bond issue of $200,000 has left this city without funds to continue work on the water tunnel through the Santa Ynez Mountains. The City Council met in an executive session with the water commissioners, and it was decided that in asking the people to vote more bonds, something more attractive to investors should be provided. The present bonds were issued in series maturing annually, and bearing 4½ per cent interest.

San Francisco.—Supervisor Rixford introduced a resolution at the last meeting of the Board including in the proposed secondary bond issue an item of $10,000,000 to provide for the purchase from the Spring Valley Water Company of the Crystal Springs, San Andreas, and Pilarcitos reservoirs and water-sheds to be used later as a part of the city's proposed Sierra supply system. It is proposed the money to be paid the Spring Valley Company for the property shall be expended by that corporation in the improvement of its remaining property, that it may be in a better position to supply the city pending the creation of the proposed Sierra system.

Oakland.—The City Council has deferred the fixing of water rates until next week, when the Peoples' Water Company will probably submit to the Council a proposal to end the controversy arising annually as to the value of the system of the water corporation, by establishing a permanent valuation on which the rates of all future years will be fixed. This proposal, not yet brought officially to the attention of the Council, and now in the hands of City Attorney McElroy, provides for the abandonment of the injunction suits brought by the Contra Costa Water Company four years ago to prevent a reduction in the then prevailing high rates which were collected up to last year when they were cut 10 per cent.

Petaluma, Cal.—The annual report of the Petaluma & Santa Rosa Railway Company for the year ended December 31, 1907, shows that during the year 620,219 passengers were carried on the railway and 8,761 on the steamers, a total of 628,980 passengers; 40,287 tons of freight were carried by the railway and 53,080 tons handled on the steamers. The total passenger-car mileage was 304,525 and the total freight and miscellaneous-car mileage was 208,216, making the total car miles 512,741. The steamers made a total of 26,250 miles. The operations for the year 1907 were as follows: Gross earnings, $216,642.45; operating expenses, $155,935.31; net earnings, $60,707.14; fixed charges, $61,106.88; deficit, $399.74. The total cost of the construction and equipment of the road to December 31, 1907, was $1,105,942.23. Of the first mortgage bonds $698,000 are issued and outstanding; of the second mortgage bonds $250,000 have been issued, $217,000 having been sold and $33,000 remaining in the treasury of the company.

TELEPHONE AND TELEGRAPH.

Vallejo.—On the recommendation of the Board of Works, the trustees concurred in the move to install a four-circuit storage battery switchboard fire alarm in the city. The improvement will cost about $1,250.

Salt Lake, Utah.—The Salina Telephone Company, with headquarters at Salina, Sevier County, has filed articles of incorporation with the Secretary of State. The capital stock is $10,000 in shares of a par value of $10 each. The officers are A. J. Lewis, president; E. M. Peyton, vice-president; H. F. Jorgenson, secretary.

San Francisco.—A demand for an increase of pay for electricians in the employ of the city is to be made by Electrical Workers' Union, No. 537, which has appointed W. L. Rhys, F. P. Noonan, and W. W. Barden to interview the joint Board of Electricity of the police and fire departments. City electricians are paid $90 monthly. An increase to $100 a month will be asked.

San Francisco.—In his annual report to the stockholders of the American Telephone & Telegraph Company, President Theodore N. Cail goes deeply into the financial condition of the concern, and states that dividends amounting to $19,206,100 were paid last year. The gross earnings of the company for the whole country, according to him, amounted to $120,753,200. The operating and general expense was $53,242,300, and the maintenance of the plant, $34,665,700. "At the close of the year," the report reads, "a valuation based on the replacement cost of the existing plant, without any allowance for franchises or unearned increment, showed $488,296,000. Against the American Telephone & Telegraph Company and its associated companies, including capital stock at par in the hands of the public, of $554,939,000. These companies had as cash on hand, quick assets and investments of $101,074,000, so that the obligations against the plant were only $453,865,000, or $34,431,000 less than its appraised value:"

ILLUMINATION.

Richmond.—The Richmond Light & Power Company has been awarded a franchise by the Trustees.

Las Vegas, N. M.—A modern electric light and power plant will be provided here in about 90 days. Dr. E. L. Woods, promoter of the enterprise, was in the city last week, and he and Mayor Bursum agreed upon the terms of a franchise that the City Council will probably grant.

San Francisco.—As a preliminary step toward fixing the gas rate for the coming year, four members of the Finance Committee of the Board of Supervisors—Broderick, Johnston, Murphy, and Jennings—at the last meeting, decided to consult with experts with the idea of engaging them to examine the plant and accounts of the San Francisco Gas & Electric Company.

Los Angeles.—At a recent conference it was decided, by a special commission on illumination appointed by Mayor Harper, to act with the Committee on Decoration, to abandon the idea of stringing decorations on the wires above those of the electric railways. It was decided that the bids for electrical work should be opened next week. The plan calls for 34 blocks, and specifications are being prepared by City Electrician R. H. Manahan.

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Electric Appliance Co.
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THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., APRIL 18, 1908 No. 16

SINGLE PHASE RAILWAY.

SAN FRANCISCO, VALLEJO & NAPA VALLEY RAILROAD.

The following paper and discussions were read by Mr. Wm. F. Lamme at the March 27th meeting of the San Francisco Section of the American Institute of Electrical Engineers:

Paper by Wm. F. Lamme.

In 1904 a contract was executed between Captain John Cross of Los Angeles and the Westinghouse Electric & Mfg. Company, for electrical apparatus to equip a railway running between Vallejo and Napa, California.

This electrical equipment is the so-called single phase 25 cycles. The powerhouse is located at Napa, near one end of the original line.

The apparatus as first furnished consisted of the following:

Power House.—Two Motor Generators. The motor, 585 horse-power, 2200 volts, 3 phase, 60 cycles, to operate off the lines of the California Gas & Electric Corporation.

The generator.—400 kilowatt, 6600 volts, two phase, 25 cycles, to deliver single phase current to each of two insulated sections of the trolley system.

One switchboard to measure and operate the above two motor generator sets.

WESTINGHOUSE SINGLE PHASE LOCOMOTIVE.

Line.—For feeding the trolley system there were furnished: Five transformers, each 200 kilowatt, 25 cycles, 6600-750 volts.

Car Equipments.—Motor equipment for the cars were furnished as follows:

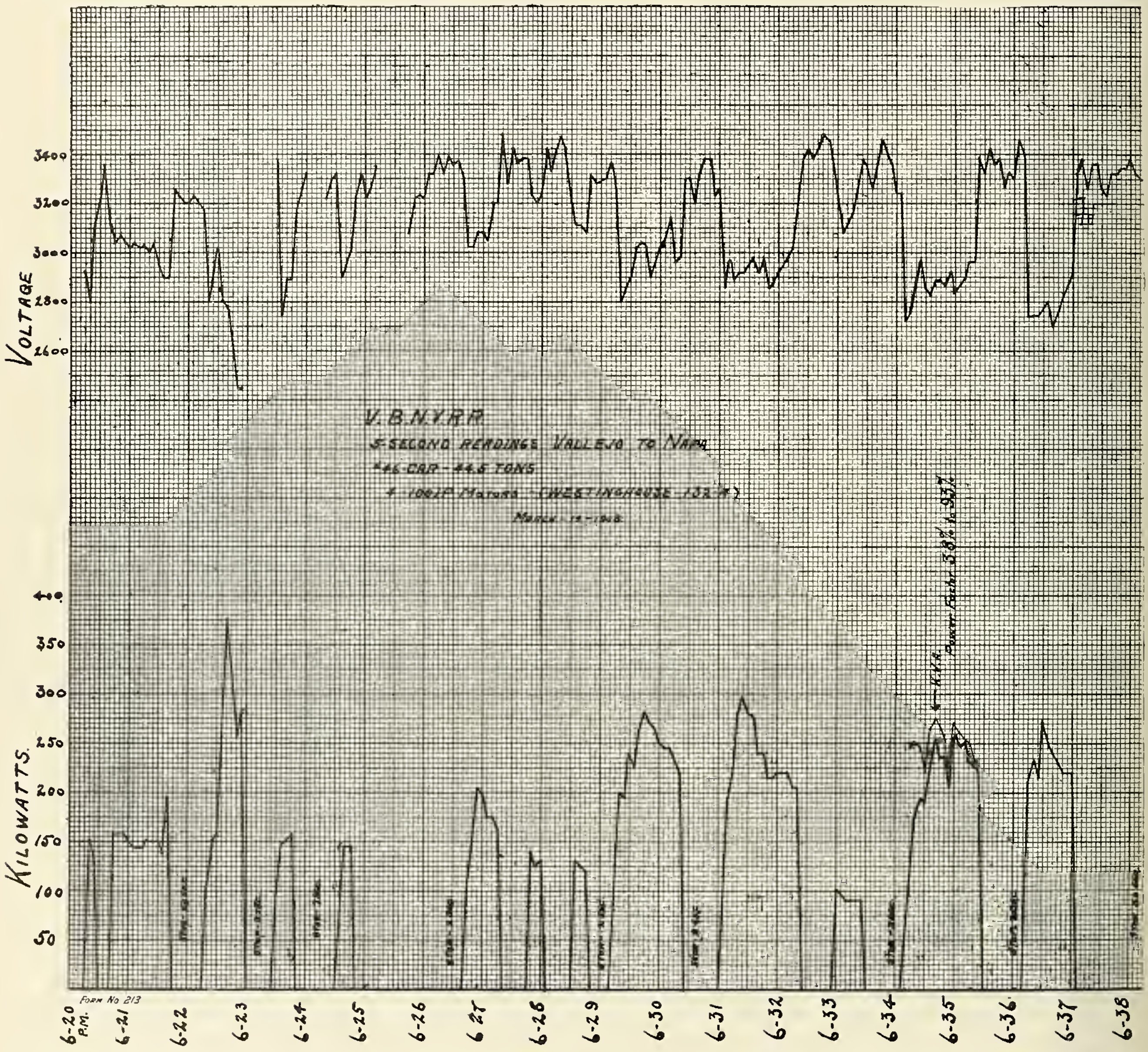
Three four-motor equipments, each 25 cycles, No. 106, normal rating, 100 horse-power.

Two four-motor equipments, each 25 cycles, No. 107, normal rating, 75 horse-power.

As first installed, the trolley line voltage was 750, the control was made by the induction regulator method; there was a seven per cent grade for thirteen miles from the power house, and the nearest step-down transformer was located nearly a mile away from the seven per cent grade.

with large sleeve insulators, also the pantagraph trolley was substituted for the standard pole and wheel.

Later, the generators were re-wound to deliver 6600 volts, single phase, instead of 6600 volts, two phase, and by the use of a superior kind of insulation, which took up but little space, sufficient room was secured for copper to keep the rating on these generators up to 400 kilowatts.



As the trolley voltage was low, gear ratios were improper for the service, and an induction regulator control was used. Coupled with this, a heavy grade distant from the power supply and improper first location of a step-down transformer, made this equipment unsuccessful in operation. Therefore, immediately, plans were agreed upon to make many changes.

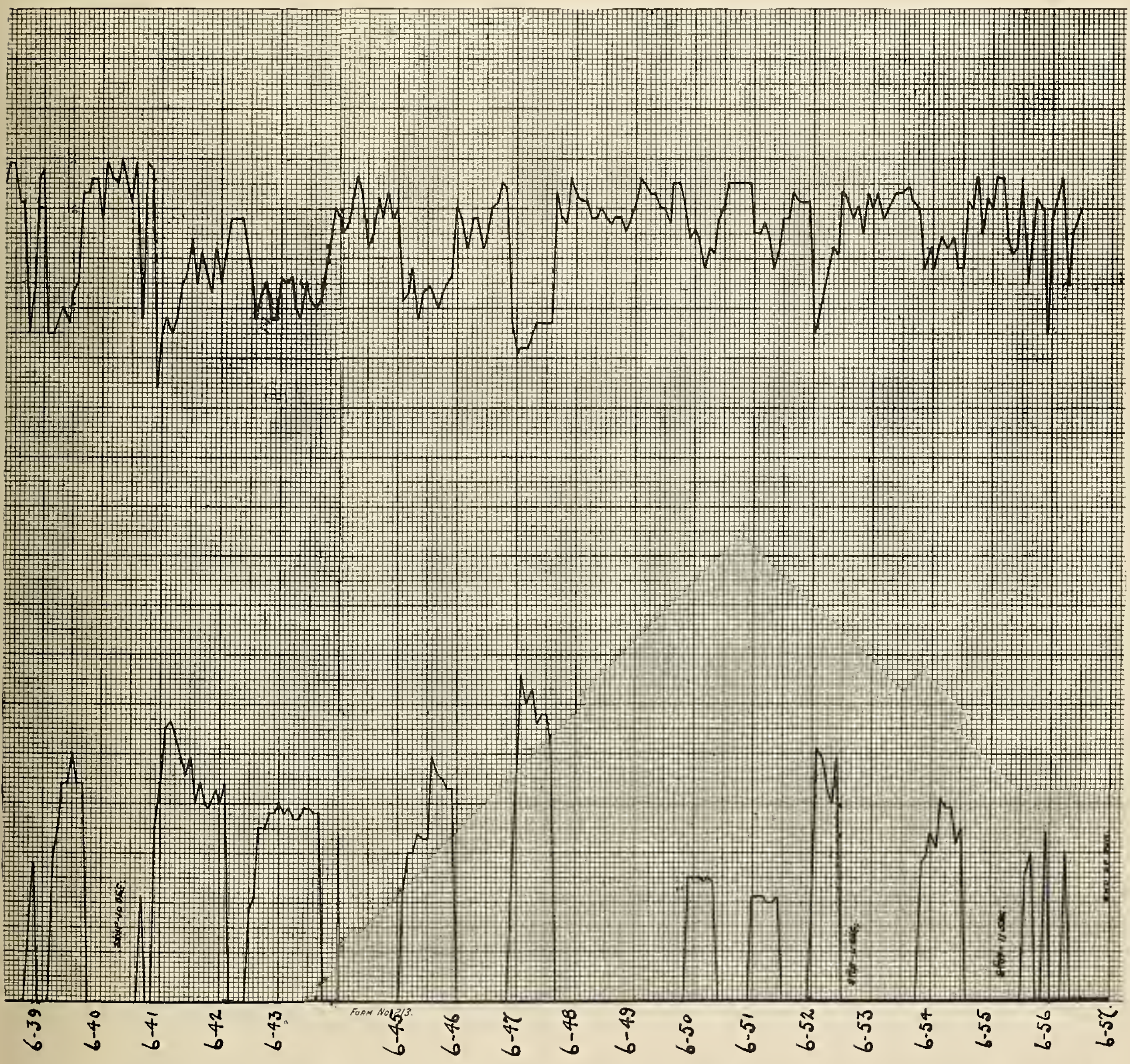
The gear ratios were changed, the trolley voltage was raised from 750 to 3300 volts, and the control was modified from induction regulator to unit switch. Instead of five transformers, each 200 kilowatt capacity, two transformers of 500 kilowatt capacity each were substituted, one placed in the power-house, and one placed near Vallejo, within a mile of the grade referred to above. Of course, with 3300 volts on the trolley, the trolley construction was changed from standard 500 volts to catenary of the well known Westinghouse type

The chief reason for changing from two phase to single phase was the one of voltage regulation. With two phase, you perceive that it is impossible to control the voltages on both phases unless the loads agree fairly well. On the Napa Valley railway system, the phases unbalanced badly, so it was concluded to re-wind for single phase, the single phase voltage to be regulated by the use of a Tirrill regulator. This plan produced very satisfactory results.

After the modifications noted above, the service given was most excellent, and so satisfactory that the local company bought five more equipments, known as 132-A, a new design of the old No. 106.

About one month ago, wattmeter readings were taken upon the new 132-A equipments. The wattmeter used is of the standard recording type. The moving parts of this meter

are very light and the friction is exceedingly small, therefore, the errors in the readings due to vibration or jostling of the car must be very slight, if not negligible. The average over 4500 miles, running in regular service, gave a result of 89 watt hours per ton mile, and with line losses approximately ten per cent, then watt hours per ton mile at switchboard = 98. From the paper in your hands, you note the ratio of input to output



of the motor generator set, ranges from 1.5 to 1—to 1.67 to 1. Taking an average of 1.6 to 1, then the watt hours per car mile at input to motor of motor generator set = 98x1.6=157.

There are several interesting features in connection with this road which should be noted.

1. The wattmeter readings are not largest at start, but rise to a maximum after the car has started. With the D. O. this is somewhat different, as a usual thing.

2. The power factor varies over a wide range from 30 to 95 per cent; lowest at start and rises rapidly with increase of speed.

3. The pentagraph trolley on this road has been modified several times. The nature of these modifications and the durability of different kinds of contact shoes would be a matter of interest.

Discussion by G. R. Murphy.

Through the courtesy of the officials of the Vallejo, Benicia and Napa Valley R. R. Co. we were allowed, on our recent visit to Napa, to go into the records of the car mileage and power consumption. About the latter part of December, the railroad company put into commission some new equipment, so it was decided to select from the records, figures for a period both before and subsequent to the date of change in equipment.

Table No. 1 includes the record of car mileage and kilowatt hour output from November 2nd to November 30th, 1907, inclusive. For this period, the consumption of energy per ton mile was 105 watt hours, and the efficiency between the 3-phase, 60-cycle bus and the 25-cycle, single-phase bus was 60 per cent.

Table No. 2 includes the record of car mileage and kilowatt hour output from March 1st to March 13th, 1908, inclusive. The consumption of energy per ton mile in this case was 108 watt hours, and the efficiency between the 3-phase, 60-cycle bus and the 25-cycle single-phase bus was 66 per cent.

The difference in results in watt hours per ton mile between the twenty-nine days of November, 1907, when the old equipment was operated and the thirteen days in March, when both old and new were being operated, may be partially accounted for by the fact that the new cars seem to be geared too high for the track in its present condition. The lower efficiency in November, 1907, compared with March, 1908, was due to the amount of construction work on hand, making it necessary to run the two motor generator sets the greater part of the time on a comparatively light load.

On the evening of the 14th of March, the committee went over the line between Napa and Vallejo. Car No. 46 was used, and was equipped with indicating wattmeter, voltmeter and ammeter. On the run between Napa and Vallejo, some readings were taken, but the interval of time between readings was too great to make them of any value. From Vallejo to Napa, however, we took five second readings. The wattmeter and voltmeter readings were taken on dead beat instruments, and are, therefore, quite correct. We were not certain, however, of all the ammeter readings except on one cycle. On this cycle, we found the power factor on starting to be 38 per cent, and on the full running speed, 93 per cent.

The curve attached shows these readings in detail.

TABLE I—NOVEMBER 2ND TO NOVEMBER 30TH, 1907, INCLUSIVE.

Car	Weight in tons	Car load in tons	Total weight in tons	Car miles	Ton miles
No. 6	34	2	36	5921	213156
No. 7	34	2	36	3064	110304
No. 8	34	2	36	4440	159840
No. 1	35.3	1.5	36.8	1368	50342
Locomotive	31	–	31	2247	69657
Flat Cars	15	6	21	4454	93534
Trailers	14	2	16	398	6368
Box Cars	29	1.5	30.5	158	4819

Total ton miles=708020

Kilowatt hour output of 25 cycle generators=74400

Watt hours per ton mile=105

Kilowatt hour input of 60 cycle motor generator set=124700

Efficiency from 3 phase 60 cycle to the single phase 25 cycle bus=60%

Car No. 6=passenger

Car No. 7= "

Car No. 8= "

Car No. 1=Baggage

Flat Cars used on construction work and it was assumed that they carried 12 tons and loaded only 50% of the time.

TABLE II—MARCH 1ST TO MARCH 13TH, 1908, INCLUSIVE.

Car	Weight in tons	Car load in tons	Total weight in tons	Car miles	Ton miles
No. 7	34	2	36	1106	39816
No. 8	34	2	36	1579	56844
No. 40	44.5	2	46.5	29.1	1354
No. 42	44.5	2	46.5	169.5	7882
No. 45	44.5	2	46.5	2113.4	98273
No. 46	44.5	2	46.5	2368.7	110415
No. 1	35.3	1.5	36.8	101.4	3732
No. 100	44.5	1.5	46	640.2	2945
Locomotive	31	–	31	992	30752
Flat Cars	15	6	21	1784	37464

Total ton miles=389477

Kilowatt hour output of 25 cycle generators=42000

Watt hours per ton mile=108

Kilowatt hour input of 60 cycle motor generator sets=63700

Efficiency from 3 phase 60 cycle to the single phase 25 cycle bus=66%

Car No. 7=passenger

Car No. 8= "

Car No. 40= "

Car No. 42= "

Car No. 45= "

Car No. 46= "

Car No. 1=Baggage

Car No. 100= "

Flat cars loaded with 12 tons 50% of the time.

Discussion by Geo. A Hearn, Chief Electrician.

In view of the fact that the operating conditions of this road were recently investigated by a committee of interested members of the A. I. E. E., I would like to present a statement regarding the maintenance of our A. C. Ry. equipments, and in doing so, would refer you to a statement published in the proceedings of February, 1907. In this issue there were assertions made regarding the maintenance of equipment which were greatly misleading, and the economic conditions were misrepresented, while the difficulties under which we were operating at that time were not mentioned at all.

It was stated in a general way that eight men were required to keep five motor cars in repair, and no mention was made of the distribution of this labor, but the reader was lead to believe that a large majority of this work was performed in maintenance of electrical equipment. In fairness to the company whose apparatus is in use on this road, I present a few figures which will show the comparison between the cost of maintaining electrical apparatus, as compared with the principal item of expense at the time this investigation was made.

For three months preceding the time this information was obtained, a total of 2321 hours work was performed on car bodies, trucks, and freight equipment, against a total of 484 hours' work on electrical equipment, and this included the remounting of electrical apparatus which had received mechanical injury while on the road.

The classification of the men referred to was as follows: switchboard operators, two; machinist, one; blacksmith and helper, two; inspector, one; helper, one; car cleaner, one.

These figures are obtained from our record of distribution of operating expenses for September, October and November, 1906, at a time when we were operating under very adverse conditions, due to an unballasted roadbed and a shortage of equipment.

The records for this period also show that one-third of the time of two of these eight men was expended on repairs and construction of track tools, drills, etc.

Since this time our equipment, both freight and passenger, has been more than doubled, and we expect to handle the work in our shop and barns with this same force, and in a more satisfactory manner than during the period referred to above.

In closing, I would like to state that the first of our new equipments has been in service since December 23, 1907, and since this date has run 14,735 miles, requiring a total of five hours' work on repair to electrical apparatus, and this was caused by the carelessness of an employee.

I do not include data regarding cost of power, as you already have a record of recent tests which will, I believe, be deserving of some consideration.

In investigating the cost of maintenance and other details of the single phase motor equipment, we find that the average cost of maintenance, repairs and sub-station operators, is approximately $540 per month. This amount includes maintenance and repair of overhead work, telephone, cars, trucks, motor equipment, inspection and car cleaning.

The average daily mileage is as follows:

1 passenger car	182 miles
1 passenger car	164 miles
1 passenger car	81 miles
1 passenger car	130 miles
1 baggage car	65 miles
Work train locomotive	86 miles

After careful inspection of the track, it would appear that the maintenance of rolling stock is very nominal, and if the track were put in first-class condition, this amount would be somewhat reduced. There is absolutely no question but that the poor condition of the track increases the maintenance account on trucks and equipment.

The maintenance does not seem heavy, as some of the old cars were operated approximately 300 miles per day, previous to the arrival of the new cars.

The maintenance figures given cover the latter part of 1907, and are lower than the maintenance during the period that the reactive control was in service.

We find that there are twenty of the original motors operating which have paper insullation between the segments, and that there are twenty-four later motors which have mica insulation. The motors operate at approximately 303 volts. In the old type equipments, the motors are all in parallel. In the new type equipments, the two motors on each truck are in series. We find that the old equipments heat more than the new equipments, and while there is some change in the design, we believe that this is accounted for in the difference in thickness of the brushes, as in the new equipment the coil s are under short circuit but seventy-five per cent of the time that they are in the older equipments. In the old equipments there are two ½x3-inch brushes per holder, giving a total of three square inches per holder. In the new equipments, there are three ⅜x2⅜ brushes in each holder, giving a total of 2.67 square inches per holder.

The width of the commutator bars in each equipment is the same. It would be interesting to know what the effect would be if narrower brushes were placed on the old equipment. The commutators of both the old and new equipments appear in exceptionally good condition, and in fact, the wear is less than would be expected on a direct current motor of the same capacity which had operated the same number of miles.

The commutators on the work car locomotive have been in practically constant service for approximately three years, and the wear on the commutator has not exceeded one-eighth of an inch.

Steel, copper, and also aluminum sliding contact shoes were used on the pantograph trolley, but the steel shoes have proven most satisfactory, and have been adopted as standard. The steel shoe is four feet long and has an effective contact with the trolley of four inches. The center of the shoe is grooved and is kept full of grease, which acts as a lubricant. Heavy grease is used in the summer time, and lighter grease in colder weather. We inspected one of these shoes which had operated 11,585 miles, and the wear was imperceptible.

We were unable to make micrometer measurements of the trolley, but from a casual inspection this wear is not very much, and cannot be considered a serious matter.

The maintenance of the pantograph trolleys is high on account of the rough condition of the track, often causing the shoe to leave the trolley wire, and when this happens, it generally means a new pantograph. The horns of the shoe at times hook over the trolley wire, but have never damaged the overhead construction.

(To be continued.)

STEAM-DRIVEN ELECTRIC POWER PLANT COSTS.†

Costs of Steam Turbine and Reciprocating Engine Power Plants per Kilowatt Capacity.

	Turbine plants.		Reciprocating engine plants.	
Excavations and foundations	$ 2.00	$ 2.50	$ 3.00	$ 5.00
Building	10.00	15.00	10.00	20.00
Tunnels (condenser water conduit)	1.75	4.00	1.50	2.75
Flues and stacks	2.50	3.50	2.50	3.50
Boilers and stokers	8.50	12.00	8.50	12.00
Superheaters	2.00	2.50	1.75	2.25
Economizers	2.00	2.25	2.00	2.25
Coal and ash handling systems	1.50	3.00	1.50	3.00
Blowers and ducts	1.00	1.50	1.00	1.50
Pumps and tanks	1.00	1.25	1.00	1.25
Piping systems	2.25	4.50	2.50	5.00
Turbo-generators (engines)	22.00	25.00	18.00	22.00
Condensers*	5.00	8.00	3.00	5.00
Exciters	.75	1.00	.75	1.00
Crane	.25	.50	.25	.50
Switchboards	2.00	3.50	2.00	3.50
Plumbing, painting, labor, etc.	1.00	2.00	1.00	2.00
Generators	....	....	10.00	12.00
	$65.50	$92.00	$70.25	$104.50

*Surface condensers for turbine plants; jet condensers for reciprocating engine plants.

To these summarized costs there needs still to be added the engineering fee which in many cases is figured as a percentage on the total cost.

It should be noted that the first and third columns of figures in the table represent costs which are exceptionally low and may be attained under favorable conditions with engineering skill. The second and fourth columns of figures represent fair average figures as ascertained from the costs of a number of plants recently erected. However, plants have been installed which cost as much as $92 per kilowatt. The main items constituting cost approximated $150 per kilowatt.

All of these figures represent costs of plants of large capacity. Small plants of about 3,000 kilowatt capacity have been erected in the West at from $120 to $130 per kilowatt, which costs may be reduced if a simple combination of machines is provided.

Referring to the table, it will be observed that the turbine plant varies from $65 to $92 per kilowatt. The main items constituting this difference are: building turbo-generators and condensers. The difference in cost of these is due to the type of turbine, the size and make of condensers and their auxiliaries, as well as the manner of assembling, all of which may reduce the size of the building required.

The difference in cost of boilers is due to the make or type and the rating of the boiler horsepower adopted by the plant designer per kilowatt capacity. This ratio varies greatly. Plants have been installed with the same type of boiler and the same type of prime mover in which the ratio varies, one value being 0.60 bolier horsepower per kilowatt generator capacity, while in other cases it is 0.75 and 0.80. This difference depends upon the experience and judgment on the part of the designer as well as the estimated ability of the future available operating force to produce steam effectively.

The difference observed in the cost of the other items may be explained by the difference in the grade of material used and the ability of one purchaser over another to secure the lowest market price.

†Frank Koester, in "Engineering News."

FUEL TESTS IN A PRODUCER GAS POWER PLANT.

The accompanying table shows the results obtained on a wide range of fuels tested by the technologic branch of the U. S. Geological Survey, under the direction of Joseph A. Holmes, expert in charge, and Robert Heywood Fernald, engineer in charge. These tests were made at St. Louis, Mo., at the fuel-testing plant which was located on the grounds of the Louisiana Purchase Exposition.

At the time this plant was erected there were but few gas-producer plants in the country burning any class of bituminous coals and many prominent engineers were in doubt as to the possibility of operating a gas engine on gas produced from coals such as are mined in the central and western States.

This branch has done a valuable service to the country in demonstrating the possibility of burning nearly all classes of low-grade fuels with good economy. As will be noted in the table, the poorer coals required a correspondingly greater quantity of the fuel to produce a horsepower.

Table of Data and Results on Representative Fuels Burned in a Producer Gas Plant at the Fuel-Testing Plant of the Technologic Branch, U. S. Geological Survey.

Fuel	Proximate analysis per cent				B. T. U. per pound of fuel		Cu. ft. standard gas produced per pound of equivalent* fuel consumed by producer plant		B. T. U. per cubic ft. standard gas	Pounds of equivalent* fuel per B. H. P. Hr.	
	Moisture	Volatile matter	Fixed carbon	Ash	As fired	Dry	As fired	Dry		As fired	Dry
Florida Peat	21.00	51.72	22.11	5.17	8,127	10,289	28.5	36.1	175.2	2.57	2.03
Average of four lignites	35.05	28.96	27.72	8.27	7,164	11,038	26.3	40.3	169.9	2.43	1.73
Average of four Illinois coals	11.51	31.81	43.46	13.22	10,651	12,030	49.6	56.1	153.2	1.66	1.47
Average of four Pennsylvania coals	3.47	19.68	67.31	9.54	13,651	14,136	71.4	74.0	141.6	1.16	1.12
Average of four W. Virginia coals	2.47	32.12	60.24	5.17	14,248	14,610	77.5	79.5	149.6	1.03	1.00

The equipment used was a 250-horsepower pressure producer with a centrifugal tar extractor and gas holder. A 235-horsepower three-cylinder vertical gas engine belted to a generator produced power which was measured by electric instruments connected with the switchboard. As will be seen, the results obtained are much better than those from steam plants of corresponding size.

Of the four Pennsylvania coals tested, two came from the lower Kittanning bed, one from the lower Freeport, and the fourth from the Pittsburg bed.

Of the West Virginia coals, one came from the Ansted bed, another from the Eagle, both of these being mined in the New River district, a third from the Pittsburg, and the fourth from the Keytsone bed.

*Equivalent fuel includes that used in the producer, and also the amount required to generate the steam necessary for operating the producer.

Spokane, Wash.—In extensions and improvements the Washington Water Power Company plans to expend this year $1,000,000. Most of this money will go into bettering the service, buying new cars and putting its conduits under ground, while a big sum will go toward the extension of its power lines. A line is now under construction from Medical Lake to Lind, Wash., while extensions are projected in the Coeur d'Alenes and in the Palouse country.

WATER POWER AS AN ECONOMIC FACTOR.

By Harrison Williams.

The cost of steam power for operating the New England cotton mills has been estimated at $36 per horsepower-year; and I may add that it can be produced at that figure only in large units, by use of high-class engines and comparatively cheap fuel. At the above horsepower-year cost, $900 earning four per cent per annum would be required to support one horsepower; or a capitalization of $80,000,000 to support as much power by steam as can be obtained from the Chelan water power.

The actual horsepower-year cost of water power takes a wide range, but, with perhaps rare exceptions, it may be included between the extremes of $5 and $15; though in the case of very large powers and low cost of development, even the smaller figure would make the property a bonanza—if all in use.

The significance of these comparisons will be more adequately realized by the statement that the last federal census report gave the amount of steam power employed in manufacturing in the United States in 1900 at 10,828,111 horsepower, and of water power at 1,642,035 horsepower; eighty-seven per cent of the whole being steam power and thirteen per cent of the whole being water power. Forty-four per cent of the water power was taken by one industry, the wood-pulp and paper industry; the cost of steam power for grinding wood-pulp being practically prohibitive. A recent census bulletin has this statement: "Abundant power is now so important in this industry that availability of water power is a more important factor in determining the location of plants than nearness to the source of supply or to the market."

Bear in mind, these statistics relate only to power used in manufacturing, and that heretofore transportation has been accomplished almost wholly by means of steam power—as it must continue to be in most situations.

As the purpose of this article is, in part, to demonstrate the pre-eminence of the section comprised in the northeastern portion of Washington, the panhandle of Idaho and extreme northwestern Montana as regards supply of water power, I quote the following from an article in the February, 1906, "Review of Reviews," by Richard H. Edmunds:

"The utilization of water power for electrical purposes promises to make this section the center of activity in that line in America. Already water power aggregating half a million or more horsepower is being harnessed for electrical work in the central South. Pittsburg capitalists are spending over $6,000,000 to generate 75,000 horsepower in the Yadkin River, North Carolina, for electrical transmission to factories to be established there, as well as to neighboring towns. On the same river two other undertakings which will aggregate about the same power and the same investment, are being financed. Near Chattanooga several million dollars are being expended in the utilization of a great power in the Tennessee

River for the transmission of 60,000 horsepower to that city. At Knoxville a plan is under way and likely to be soon actively in operation, involving an outlay of $2,500,000. New York and Southern capitalists are developing under one management several powers which will total over 100,000 horsepower, costing $7,000,000 to $8,000,000, to be tributary to Charlotte and neighboring towns, and about 100,000 horsepower is being developed in the vicinity of Atlanta."

As between the Atlantic Southeast and the Pacific Northwest I think the reader will have no difficulty in settling the question of pre-eminence after examining the following table, compiled from a large mass of government reports on stream measurements:

ratio stream, and besides, has three lakes, two of them of considerable magnitude, in which water may be held back, so, of the 28,130 second feet discharge 10,000 may be safely reckoned on for power all the time—and as much more a good deal of the time as it may be an object to install plants for. Of the 750 feet fall between Lake Pend d'Oreille and the Columbia, 550 feet at the least may be utilized, giving the enormous amount of 500,000 horsepower; this being only twenty-six per cent of what the figures would become by the utilization of all the water—28,130 second feet—and all the fall—750 feet.

By use of the waters of the Kootenai, Clark's Fork, the Columbia at Kettle Falls, the Spokane, not to mention the Chelan, several hundred thousand horsepower can be added to the above.

Stream Measurements.
From U. S. Water Supply Papers.

Name of Stream—	Year	Second Feet Max.	Min.	Mean	Ratio of Max. to Min.
		July	Oct.	6 Mos.	
Pend d'Oreidle at Priest River, Idaho	1903	113,700	14,230	27,785	8 to 1
		June	Dec.		
Pend d'Oreidle at Priest River, Idaho	1904	93,000	7,830	28,130	12 to 1
		July	Dec.	6 Mos.	
Pend d'Oreille at Priest River, Idaho	1904	86,700	7,830	18,157	9 to 1
Hudson at Mechanicville, N. Y.	1903	36,283	705	9,160	80 to 1
Hudson at Ft. Edwards, N. Y.	1903	35,780	360	5,687	99 to 1
James at Buchanan, Va.	1903	31,050	410	3,090	76 to 1
James at Cartersville, Va.	1904	35,700	755	4,575	47 to 1
Yadkin at Salisbury, N. C.	1903	76,200	1,500	6,850	51 to 1
Yadkin at Salisbury, N. C.	1904	19,320	1,050	2,873	18 to 1
Flint at Woodbury, Ga.	1903	25,750	290	1,888	89 to 1
Tennessee at Knoxville, Tenn.	1903	124,070	2,180	14,527	57 to 1
Androscoggin at Rumford Falls, Me.	1902	18,468	1,580	4,396	12 to 1
Merrimac at Garvins Falls, N. H.	1905	32,760	1,090	3,840	30 to 1
Potomac at Point of Rocks, Md.	1902	218,700	1,296	14,500	168 to 1
Potomac at Point of Rocks, Md.	1903	99,590	2,000	12,480	50 to 1
Potomac at Point of Rocks, Md.	1904	38,500	900	6,330	43 to 1
Chattahoochee at West Point, Ga.	1904	29,340	800	3,016	37 to 1
Chattahoochee at West Point, Ga.	1905	32,340	1,090	4,365	30 to 1
Susquehanna at Williamsport, Pa.	1904	135,100	830	9,450	163 to 1
Catawba at Rockhill, S. C.	1902	79,400	2,700	5,112	29 to 1
Catawba at Catawba, S. C.	1904	24,850	810	3,545	31 to 1
Grand at Grand Rapids, Mich.	1905	49,340	1,753	5,050	28 to 1
St. Joseph at Buchanan, Mich.	1904	6,545	1,436	3,400	4.6 to 1
Missouri at Townsend, Mont.	1901	22,880	1,020	5,961	22 to 1
Colorado at Yuma, Arizona	1902	59,200	3,050	10,970	19 to 1
Colorado at Yuma, Arizona	1904	51,170	3,342	13,922	15 to 1
Mississippi at Anoka, Minn., May 8, July 21, Aug. 1 (freshet period)	1905	14,950	27,150	15,570	to 1
Chelan at Chelan Falls, Wash.	1904	8,835	500	2,722	17 to 1
Chelan at Chelan Falls, Wash.	1905	9,200	776	2,503	12 to 1
Wenatchee at Wenatchee, Wash.	1905	8.780	550	2,735	16 to 1

In the absence of retaining reservoirs like Lake Chelan, only about one-third, on an average, of the stream's discharge is available for power, somewhat more where the ratio between the maximum and minimum is low, and a good deal less where it is very high. It will be seen by reference to the table that in one case in the Southeast as much water runs off in one day as would run off in 168 days at the lowest stage. In the case of the streams having exceptionally high ratio—a feature characteristic of the streams of the "Piedmont" region of the Southeast—for several months in the year the second column would be a truer index in the matter of power than the third column. The fact is, those powers have been greatly over-rated in the above excerpt, but accepting the claim made therein the Pend d'Oreille alone has as much available power as the whole group. We have in that stream only a very simple problem in arithmetic to solve, from definite data. One cubic foot of water per second under eleven feet of head, giving eighty per cent of the theoretical as useful effect, produces one horsepower. The Pend d'Oreille is a low

The Chelan water power makes a comparatively small showing in the above table, whereas it is in fact one of the largest unit water powers—that is, admitting of all being utilized in one installation—in the whole country. Lake Chelan, which presents a striking object lesson on the importance of reservoirs, can be given capacity sufficient to permit of the water all being drawn through the wheels of the power plant, either at a uniform rate or as occasion may require—the power having direct connection with the reservoir—so that the entire potential capacity of the Chelan River may be realized; the single instance in the case of a large water power in the United States. Lake Chelan also presents an object lesson in connection with a piece of history which I need not relate here, on the subject of government control of reservoirs, in accordance with the president's recent suggestion; so that they shall not be tampered with in order to serve private or merely local interests.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX APRIL 18, 1908 No. 16

EDITORIAL.

SINGLE-PHASE TRACTION.

The paper and discussion on the operation of the single-phase equipment of the San Francisco, Vallejo and Napa Valley Railroad, published in this issue, presents an interesting account which will prove of practical value to all operating, or contemplating the installation of such a system. A committee of five members of the San Francisco section of the American Institute of Electrical Engineers were given full access to all the records of this company, and also made a series of tests themselves. It is the pioneer western installation, having been in operation almost three years. In fact, there are but two other single-phase railroads in America that have been running longer than this, and they by only a few months. Today there are about thirty single-phase roads, with a total length of nearly one thousand miles. This development has followed the advent of the commutator type-alternating current motor, four years ago. Such motors may be either of compensated repulsion or compensated series, the former having been greatly perfected by Mr. Lamme. For traction work it depends for speed regulation upon the change in the transforming ratio.

Originally operated at a trolley voltage of 750, the system was soon changed to 3,300 volts. The control was modified from induction regulation to unit switch method. The trolley construction was changed from standard 500 volts to catenary, and a pantograph trolley was substituted for wheel and pole.

The single-phase motor for traction purposes is fast passing beyond the experimental stage, and has already demonstrated its economy in competition with direct current installations whose conversion losses are necessarily high. The design of electrical machinery is being so rapidly improved, that one system is no sooner in successful operation than it is superseded by another even better, and the men who have the courage to adopt untried apparatus are earning the well merited gratitude of those who follow.

THE ELECTRIC CLUB.

The electrical men of the Coast are being invited to join in the organization of a club. This project was ready to be launched just two years ago, but the disrupting effects of the disaster of that time have delayed its perfection until now. Personal needs and widely scattered business interests have so occupied the attention of possible members that the advantages of social organization have been neglected.

The proposed club offers a convenient center for congenial clans already organized, and also a rendezvous for those unattached. The former include the Electrical Trades Association, the Electrical Contractors Association, the local members of the American Institute of Electrical Engineers, and the Sons of Jove. Each of these organizations have frequent meetings and dinners, whose expense might be reduced and whose attractiveness increased if held under the auspices, or, at least, in the quarters of such a club. It would in no way supersede or assume their functions; on the contrary, it would help them by promoting comfort and sociability.

As a nucleus, the club will rent and furnish a handsome room in a central building, offering every convenience of a first-class grill and hotel. There electrical men can foregather and amicably meet one another on a common basis. Visitors may be put up for a meal or a month where they can meet those they wish. Later an assembly hall will be provided, and regular meetings to hear practical papers on electrical matters are proposed.

To carry through these plans there is necessary the co-operation of every electrical man in the vicinity. Fixed charges will be reduced to a minimum, but these must be regularly met. So the committee is soliciting a membership large enough to guarantee financial as well as social success.

Representation without taxation is no more logical than was its antithesis as shown at the Boston Tea Party; but the dues are low enough to be within the means of all, and further, the greater the membership the lower the individual tax. It seems strange that a large and important industry on the Pacific Coast should have so little coherence among those engaged in it, especially when we consider their various and desirable talents. So be ready when the committee calls upon you.

PUBLICATIONS RECEIVED.

"Steam Electric Power Plants," by Frank Koester, is a 450-page practical treatise on the design of central light and power stations, and their economical construction and operation. It includes a general discussion of every phase of steam-electric power plant construction, giving details by pictorial rather than textual means. There are 268 half-tone illustrations and sectional drawings of power plants all over the world. The author's treatment of the subject is in conjunction with the cost of construction, installation, operation and maintenance. The arrangement is logical and essentially practical in its successive presentations of the problems that a designer must consider. In the design of the building he urges that more attention be paid to the architectural work, saying: "A pleasing appearance can always be secured without any additional expense." Boilers and all auxiliary apparatus are treated in a general but thorough manner, with particular stress on piping, as this is the most important feature after the general lay-out has been completed. This chapter is accompanied by several illustrations of typical installations of piping, supports, and tables of sizes. A short comparison of engines and turbines is followed by a more detailed classification of each kind of prime-mover. The discussion of electrical equipment is limited, being primarily intended for the information of the mechanical engineer. A chapter is devoted to the design of small power plants, and another to power-plant testing. The volume is closed with descriptions of typical American and European light and power plants. In this admirable collection it is to be regretted that the author makes no mention of oil as fuel, with its accompanying storage tanks, receivers, pumps, atomizers, etc. The material has already appeared in many of the technical periodicals, but this book classifies and brings into convenient form the results of an expert examination of many plants. It is published by D. Van Nostrand Co., of New York, for $5.00.

ELECTRICAL TRADES ASSOCIATION.

The sixth annual meeting of the Electrical Trades Association was held at Solari's Grill, Friday, April 10th, 1908. This was the largest meeting of the Association ever held, there being twenty-three electrical houses represented, and thirty-two present at the table. Following out the regular custom, a luncheon was served, and the business of the meeting was transacted after the luncheon.

The Electrical Trades Association is a credit association, formed amongst the electrical jobbers and others engaged in the electrical business. This association is a branch of the National Association, and organized May 19th, 1902, with fourteen members. There are now thirty-four members, spread pretty well over the Pacific Coast States.

The annual reports of the president, Samuel H. Taylor, and of the secretary, were read. The officers elected for the ensuing year are: Samuel H. Taylor, president; R. W. Valkenburgh, vice-president; Harry Sayles, J. A. Vandegrift, and A. E. Drendell, of the executive committee.

After the regular business of the Association was transacted Mr. T. E. Bibbins, of the General Electric Company, was requested to address the meeting, on the subject of "The Sons of Jove." He urged all engaged in electrical business to join the order.

Mr. Scribner was also requested to address the meeting, on the subject of "The Formation of an Electrical Club." He told, in a very interesting way, of the plan for organizing a Social Club composed of men engaged in electrical business and kindred lines. After two hours' session the meeting adjourned, and it was voted by all present as having been the most successful meeting of the Electrical Trades Association ever held.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. H. J. Gille, of the Minneapolis General Electric Company, will come before the N. E. L. A. Convention this year at Chicago, as editor of a paper on the "Preparation of a Campaign." This paper has been divided into five sub-titles, and will consider (a) Field Work and Other Essentials; (b) Analysis of Customer's Accounts; (c) Proportion of Lamp Equivalent Lost to Lamps Connected—Showing Percentage in Cities of Varied Population; (d) Policy of Handling Complaints; (e) Policy of Handling Collections. Mr. Lewis A. Furguson, of the Commonwealth Edison Company, of Chicago, will edit a paper on the "Relation Between the Engineering and Commercial Department."

JOVIAN REJUVENATION.

A rejuvenation of the Sons of Jove was held at Solari's, in San Francisco, on April 10th, with about forty Jovians present. The following were initiated:

H. D. Boschken, Charles O'Donald Blanchfield, Lyman Roscoe Boynton, Wallace Wheaton Briggs, Robert James Davis, Cass Lord Gilson, William Wallace Hanscom, Arthur Hobart Halloran, William Stultz Hanbridge, George Alfred Hearn, Benjamin Christian Holst, Edwin Ames Hunt, George Irving Kinney, Frederick Valentine Meyers, Roscoe G. Rice, John G. Sutton, Ernest M. Schlessinger, Robert Waldo Van Valkenberg, and Russell Lewis Waldenburg.

After the ceremony a sumptuous banquet was spread, concluding with speech-making and music from the Jovian Choir.

PERSONAL.

James M. B. Irwin, Los Angeles representative of the Electric Appliance Co., was in San Francisco last week.

John M. Klein, of Mathias Klein & Sons, of Chicago, visited San Francisco recently, on a hurried trip.

C. W. Koiner has resigned as general superintendent and engineer of the Los Angeles Gas & Electric Co., to become general manager and engineer of the municipal lighting plant at Pasadena, California.

E. E. Potter has succeeded H. F. Grant, resigned, as general manager of the Seattle Electric Co. Mr. Grant continues his duties as Pacific Northwest district manager for Stone & Webster.

Melville Dozier, Jr., has been appointed assistant general manager of the Northern Electric Railway at Chico, Cal. Mr. Dozier formerly was president of the Vallejo & Northern Railway Company, which is building an electric line from Sacramento to Vallejo, Cal.

E. E. Keller, for over twenty years connected with the Westinghouse interests, and for 14 years vice-president of The Westinghouse Machine Co., having completed his duties as receiver and general manager, severed his connection with the management of that company on the first of this month. Mr. Keller will take a much-needed rest, and will then devote most of his time to several personal interests.

TRADE CATALOGUES.

The Electric Appliance Co., 726 Mission Street, San Francisco, sends leaflets on the Benjamin "Arc Burst" and the Perkins "2000" switch.

REMOVAL NOTE.

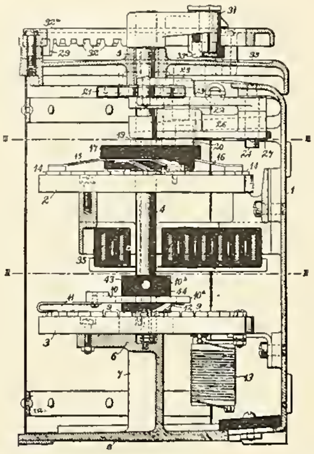
The Brookfield Glass Co. announce the removal of their general offices to the U. S. Express Bldg., Trinity Place, Greenwich and Rector Streets, New York City.

The San Francisco office of the Allis-Chalmers Company has been moved from 604 Mission to the south east corner of Second and Mission streets where they are now permanently located.

PATENTS

CONTROLLER FOR ELECTRIC MOTORS. 883,200. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.

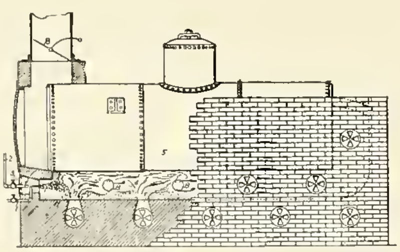
In a controller for electric motors, the combination with an annular set of stationary contact terminals, a pair of rigidly connected but electrically independent contact arms to engage said contact terminals, a second set of stationary contact



terminals similarly disposed in a plane parallel to that of the first set, and a single movable contact arm therefor, of a rotatable shaft for said movable contact arms, and means for temporarily disconnecting pair of contact arms from shaft after the shaft has been rotated through a predetermined angle in either direction from the "off" position of the controller.

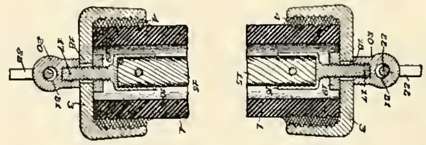
FLUID-FUEL FURNACE. 883,260. Edward C. Voorheis, Sutter Creek, Cal.

In a fluid fuel furnace for the purpose set forth, the combination of a combustion chamber formed to constitute a continuous, completely free passage for the gaseous fuel therethrough, a fuel feeding device to introduce fluid fuel at one end of the combustion chamber of the furnace consisting of a controllable conduit for liquid fuel and a controllable conduit for gaseous fluid under pressure, the exhausts of both of



said conduits being adjacent, whereby the liquid is atomized, and a damper to regulate the flow of the inflaming gases through the combustion chamber, the bottom wall and side walls of the furnace being each provided with a series of valve controlled air inlet passages arranged at regular intervals whereby a regular and progressive combustion of fluid fuel throughout the entire combustion chamber is effected, combustion being initiated and sustained only at predetermined points along the combustion chamber.

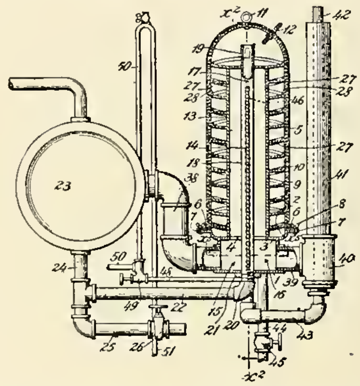
INSULATOR. 883,397. Walter T. Goddard and John S. Lapp, Victor, N. Y., assignors to The Locke Insulator Manufacturing Company, Victor, N. Y.



In an insulator, attaching devices, and a pair of tension elements made of insulating material connecting the attaching devices and having different tensile strength.

OIL-GASIFIER. 883,472. William H. Neher, Inglewood, Cal.

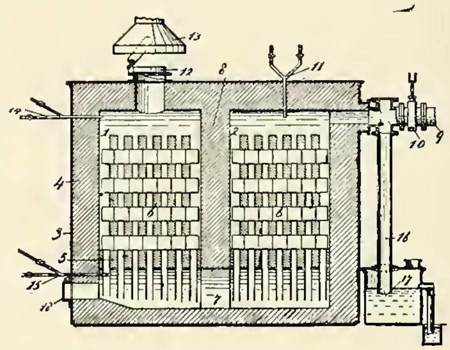
A base, a vaporizing member above the base, a dome housing and nesting with the vaporizing member, flanges on the vaporizing member extending to the wall of the dome



and forming a series of chambers, the flanges having openings whereby a tortuous passage is formed, means for conveying fuel to the flanges, means for conducting heated air through the tortuous passage, and means for conveying gas from the interior of the dome.

PROCESS OF MAKING GAS AND COKE. 883,466. Leon P. Lowe, San Francisco, Cal.

The process of making gas and coke which consists in simultaneously highly heating two segregated bodies of loosely piled refractory material and a retort chamber, discontinuing the step of heating, passing steam into contact with one body of refractory material to superheat the steam,



passing oil directly into the retort chamber to distil the oil, retaining the non-volatile components of the oil in chamber in the form of coke, and passing only the steam so superheated and the volatile portion of the oil so distilled together into contact with the second body of refractory material, to make combustible gases.

INDUSTRIAL

HADAWAY ELECTRICALLY HEATED STAMPING PRESSES AND GLUE POTS FOR BOOKBINDERS.

The illustration shows two electrically heated devices that are rapidly gaining favor with bookbinders—the stamping press and the glue pot. The finer sort of work that the binder has to do requires great cleanliness to make it profitable, while edition and pamphlet work require dispatch. These electrical devices fulfill both requirements. They are always ready for service and always maintain a uniform temperature so that no delay need ever be experienced. The cleanliness of electric heat does away with the spoilage of costly binding materials that frequently results from the use of gas or steam, no matter how careful the binder may be.

The glue pot is provided with a patent water circulating device that brings the glue up to the proper temperature in much less time than would be otherwise required, and with a cut-out which reduces the current so that just enough is used to keep the glue at a fixed temperature.

The design of the stamping press head is such that the heater and its insulation is entirely protected from the direct pressure, the head being practically a solid block of iron. This form of construction is very rigid and the head has no tendency to give and reduce the pressure. The heating element is divided into sections, permitting the heat to be localized in the center or in the ends, or to spread over the entire head, as desired.

Both the glue pot and stamping press are manufactured by the Hadaway Electrical Heating and Engineering Company and sold by the Westinghouse Electric and Manufacturing Company.

TRADE CATALOGUES.

Appleton Electric Company, of 224-226 East Washington Street, Chicago, Ill., and 833 Folsom Street, San Francisco, send an illustrated description and price list of Alnilets, a line of conduit fittings.

PUBLICATIONS RECEIVED.

The main paper in the April Proceedings of the American Institute of Electrical Engineers is by Henry Floy, on "The Engineer's Activity in Public Affairs." The balance of this number is made up of notes, comments and discussion.

INSULATORS FOR EXTREMELY HIGH VOLTAGE LINES.

The frame type insulator shown in Figure 1 was designed for lines requiring 150,000 volts, line pressure. It is stated that it will stand a spray test of 280,000 volts, leaving a large factor of safety, and carry a mechancial load of 20,000 pounds. It can be constructed to carry as much more as desired by

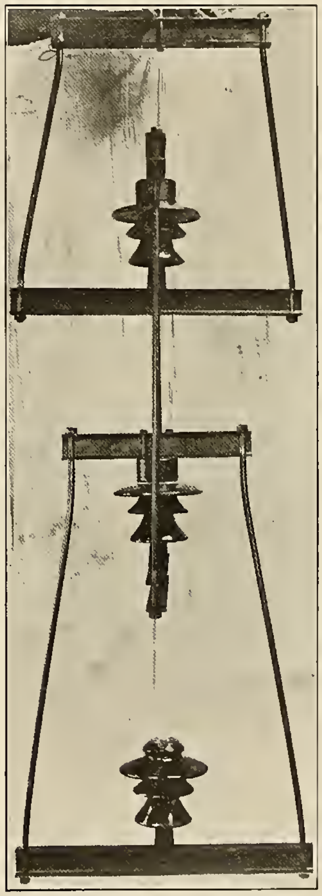


FIG. 1.

increasing the eye beams and side rods and the bearing surface of the porcelain. The frames are interlocked like a chain so that the line will not come down. All the porcelain parts are under compression and are designed to have a surface large enough to carry the required mechanical load with a large factor of safety. Under an electrical test this insulator does not show the usual static stresses and is extremely quiet up to the arcing point which takes place between the frames. In case of an arc from lightning, it will take place between the frames and not injure the insulator. These insulators are furnished in any size for line voltages from 70,000 volts up to 300,000 with a factor of safety of 2 under a spray test, and any mechanical load desired. It is designed for the hanging type, but can be supported at either end and can be used horizontally or perpendicularly. It is manufactured by the Lima Insulator Company, Lima, N. Y., as designed by Mr. F. M. Locke, whose patents are now pending.

Figure 2 illustrates a 450,000-volt, 150-kilowatt transformer used to test the above insulator, and is installed at the Lima Insulator Company's plant. It was made by the Central Laboratory Supply Company, Lafayette, Ind. Figure 3 shows porcelain bushings manufactured by the Lima Insulator Company for Locke 450,000-volt, 150-kilowatt transformer and is insulating successfully the lead wires. These bushings are oil-filled and the holes through the top caps are to support the coke coils at each terminal. They weigh about 200 pounds each.

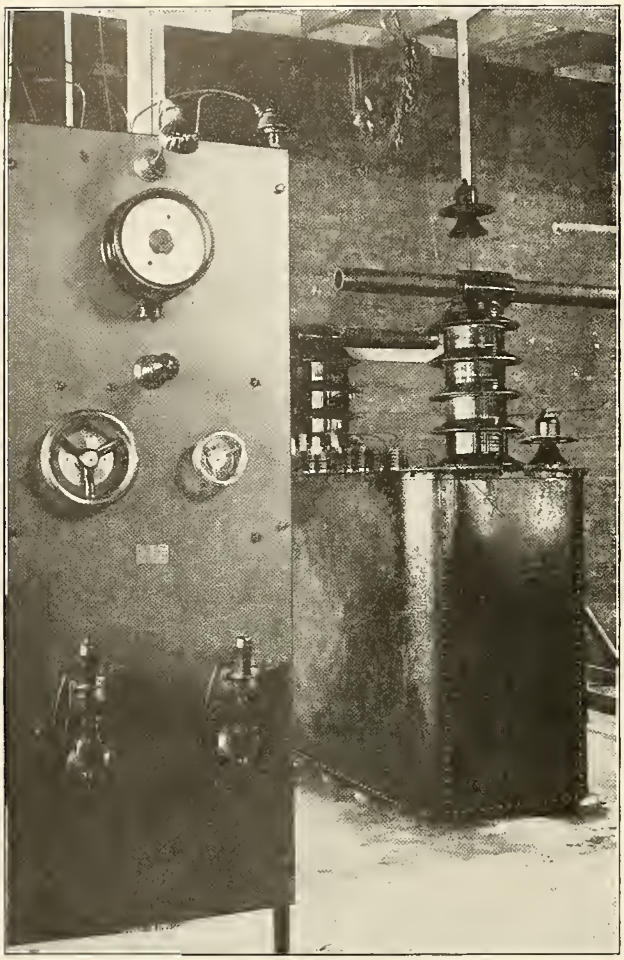


FIG. 2.

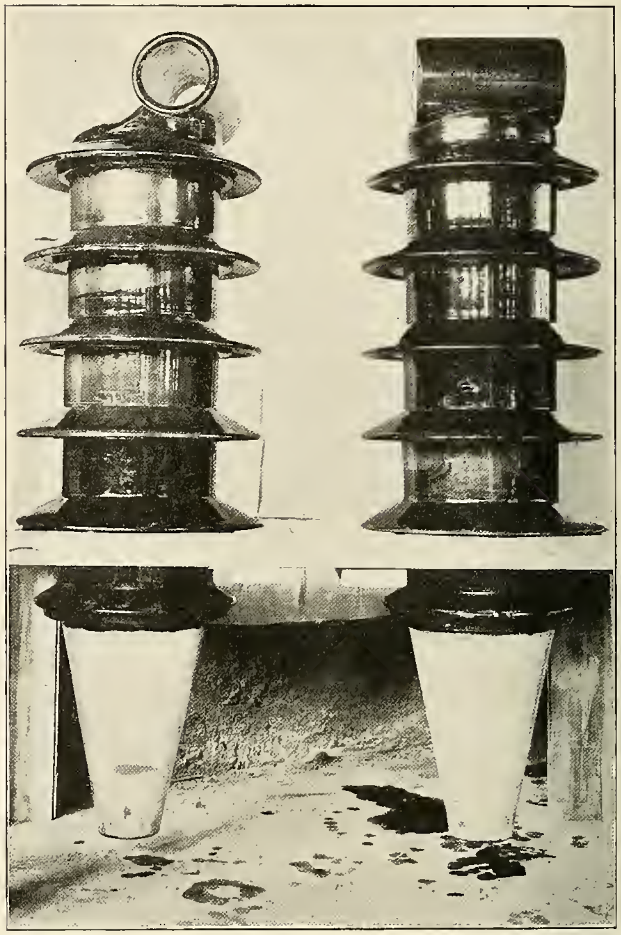


FIG. 3.

CURTIS TURBINE BUSINESS.

A number of interesting facts are revealed in the statement of Curtis Turbine sales which follows:

ORDERS to Dec. 31, '07.	Number of plants Capacity 1000 kw. and less	Capacity above 1000 kw.	Total number of plants	Average Kw. Cap. of plants	Total Kw. capacity
Central Station and Railway Traction	71	190	261	3,778	986,020
Industrial plants and Miscellaneous	243	45	288	305	87,675
Totals	314	235	549	1,956	1,073,695

	Number of machines	Average Kw. capacity per machine	Total Kw. capacity
Installations to Dec. 31, 1907	943	857	807,610
Orders on hand Dec. 31, 1907	153	1,739	266,085
Total Sales to Dec. 31, 1907	1,096	980	1,073,695
Orders for fiscal year ending Feb. 1, 1908	325	890	286,320

The most noticeable single item is the total capacity sold to December 31, 1907, 1,073,695 kilowatts, or about 1,556,000 brake horsepower. This is the strongest indication of the advance of the steam turbine generating unit that has ever been published. That this advance is accelerating rapidly is shown by the amount of the sales of Curtis Turbine Generators for the past fiscal year of the General Electric Company, 286,320 kilowatts capacity, or more than 25 per cent of the total sales since the Curtis turbine was introduced.

Another fact of considerable interest is the large number of plants for which the Curtis turbine has been selected as prime mover. The large range of sizes in which this turbine is sold is probably responsible for the great variation in average sizes of plants in which it is used. The large central stations and electric traction enterprises with an average size of 3,778 kilowatts plant capacity strikingly differ from the industrial plant of 305 kilowatts average capacity.

INSPECTION TRIP.

The students in the College of Engineering, University of Colorado, recently inspected various power plants at Denver, Georgetown and Idaho Springs, under the direction of Professors M. S. Ketchum, H. S. Evans, and J. A. Hunter. There were over sixty students from the junior and senior classes in the party.

NEWS NOTES

TRANSMISSION.

Redding, Cal.—The Southern Pacific will begin work at once on its large power plant, twelve miles west of Dorris, on the Klamath River.

Placerville, Cal.—Ambrose Regalia has filed notice of location and appropriation of the waters of Talbet Ravine at a point in Section 13, Township 9 north, range 12 east.

Ukiah.—Current from the Snow Mountain Water & Power Company's plant on Eel River was turned on at Ukiah for the first time last week. The power line will be extended to Santa Rosa in a few months, and contracts for the work are already being let.

Red Bluff, Cal.—J. W. Roper and L. A. McIntoch have filed a notice of appropriation of 5,000 inches of water in Bee Gum Creek. The creek is to be dammed where the water is to taken out, and the water conducted by pipes and ditches to a power site. The power is to be used in generating electricity.

Sparks, Nev.—The directors of the Selby Consolidated Mining Company have closed a deal with the Truckee River General Electric Company for power and for the installation of electric machinery for the operation of a 60-ton Kinkead mill to be installed at the camp of Jumbo, about 22 miles south of Sparks.

Ogden, Utah.—As a preliminary to the erection of a municipal power plant and the installation of a municipal water system, A. E. Parker, city engineer, acting under the direction of Mayor Brewer and the City Council, filed two applications with the State engineers last week in South Fork Canyon, a tributary stream to Ogden River.

Sacramento, Cal.—At the last meeting of the Board of Supervisors, through A. M. Seymour, as attorney, and C. L. Waller, as agent, the Great Western Power Company made application for a franchise to construct electrical lines throughout the county, including the river islands, for wires to run along, over and below the county roads. The company proposes to extend its lines to San Francisco.

Marysville.—The Great Western Power Company has secured permission from the Levee Commissioners and the City Council to install a derrick and clam-shell bucket at the foot of C Street for the purpose of loading sand from the Yuba River into the Western Pacific cars, the sand to be transferred over the Western Pacific tracks to the site of the big power plant, in course of construction above Oroville.

San Francisco.—D. G. Scofield, Vice-President of the Standard Oil Company, has given out the following statement: "There is no truth in the statement that the Standard Oil Company is concerned in a deal by which all the gas, electric light and power companies in Northern California will be controlled by the Standard Oil interests. Similar statements have been made before, and they were denied authoritatively and positively. The Standard Oil is not concerned in any way in a deal for the purchase of the Pacific Gas and Electric Corporation.

ILLUMINATION.

Rawhide, Nev.—The Rawhide Light & Power Company has been granted a franchise for supplying the town of Rawhide with electric power and light for general purposes.

Los Angeles, Cal.—At the special meeting of the City Trustees, last week, the bid of Robert Weiss of $50 for a franchise for a gas plant for Upland was the only one received, and was accepted.

Rawhide, Nev.—A consignment of poles for the Rawhide Light & Power Company has arrived, and two 80-horsepower engines are now en route here. The work of erecting the power house for their housing is to be started soon.

Pacific Grove, Cal.—A company has been formed to supply gas for this city. It will be under the name of the Pacific Grove Heat, Light & Power Company, under which title H. S. Hales, S. J. Evans and Will S. Smith, of Los Angeles, have filed articles of incorporation. Offices will be both in Los Angeles and Pacific Grove.

Pasadena, Cal.—Unless the Pacific Electric Company repairs its right of way on Fair Oaks Avenue, West Colorado Street, and Salt Lake Avenue, where changes have been made in the tracks, within forty days after passing the ordinance which was placed on the first reading last week, the City Council states its intention of declaring the company's rights to operate cars on those streets under its franchise no longer in effect.

Alameda, Cal.—The Electricity Commission of Alameda is in financial difficulty. At a special meeting Mayor Taylor, Deputy Auditor Croll, and members of the City Council endeavored to straighten out affairs, in order that the Commission can proceed with the new fireproof building, for which $50,000 was voted at a recent bond election. The Commission borrowed heavily from the general fund of the city before getting the bond money. Then it arranged to pay thousands of dollars' worth of bills for new machinery, and between paying these bills and paying back what it owes to the general fund, the Commission has not sufficient money to pay for the new building. The charter requires that before such a contract can be let and work started, all of the money required to pay for the undertaking must be in the city treasury and apportioned to the proper fund.

San Francisco.—At the last meeting of the Public Utilities Committee the matter of the city receiving pay for the privilege of operating cars by overhead trolley on the outer Market Street tracks from Sutter Street to the Ferry Building was talked over, but President Boeckman, of the Sutter Street Company, and Thornwell Mullally, of the United Railroads, refused to make any offer. Mr. Boeckman said his company had expended $15,000 in paving between the tracks in question, and Mr. Mullally stated that the company had expended about $10,000,000 in constructing its lines, paid about one-twentieth of all the taxes received by the city, and did not feel called upon to offer any sum for the privilege. The company's temporary permit does not expire until April 10th, and the committee took the matter under advisement.

TRANSPORTATION.

Santa Cruz, Cal.—The Trustees of the Water and Light Committee were authorized to extend a two-inch water main on Monroe Street.

San Francisco, Cal.—The United Railroads will be permitted to operate on the double tracks in Market Street, from Sansome to the Ferry landing, until June 1st.

Prosser, Wash.—A preliminary survey will begin at once by the Prosser Traction Company of a line from this place south to the Columbia River and to Bickleton.

Spokane, Wash.—A traction road, seventy-seven miles in length, will be constructed from Priest Rapids to the Northern Pacific at North Yakima, tapping the lands now being put under water by the Hanford Irrigation Company.

Chehalis, Wash.—An ordinance has been introduced in the City Council to grant to Eugene A. Marsh the right to construct a street railway, and also an ordinance to grant the same party the use of the streets for telephone and telegraph purposes.

Eugene, Ore.—Work on the Eugene-Springfield electric line has been started just beyond Fairmount, and will not cease until the line is completed to Springfield. The cars will cross the track as soon as the connection is made, and service given to the end of the line.

Portland, Ore.—The surplus earnings of the Portland Railway, Light & Power Company during the coming year will be turned back into the improvement of the street railway lines and the electric light and power service. Not only that, but from $500,000 to $1,000,000 additional will be expended by the company on permanent betterments and extensions this year.

San Diego.—The City Council has passed a resolution awarding the San Diego Electric Railroad Company a street railway franchise to construct and operate for a period of 25 years a street railway commencing at the center of the intersection of Washington Street with Hawk Street, thence running north on Hawk Street to the center of the intersection of Hawk with Lewis Street, and thence running west to the intersection of Lewis Street with Ibis Street.

Chicago, Ill.—At the meeting of the transcontinental lines, held in Chicago in March, 1907, it was arranged to publish in connection with oil rates westbound the oil mixture as provided by the western classification. This change was intended for the new transcontinental tariff, but because of the delay in publishing this, tariff carriers have been requested to make immediate publication in supplement. The eastbound oil rate will also be made to carry the same mixture.

Nevada City, Cal.—D. E. Morgan, president of the Nevada County Oil Company, and Sherman W. Marsh, one of the directors and a heavy holder of the company's stock, have returned from Bakersfield, where they made a thorough inspection of the wells that are being operated by the company. The company now has eleven wells producing. From these eleven wells they are turning out a gross output of about 13,000 barrels of oil a month. On April 1st another well was started.

Yuba City, Cal.—One of the latest railroad propositions in Sutter County, is that of a belt-line railroad to be run so as to take in the section of the county lying south and west of Yuba City. The scheme is one being talked up by a few prominent Marysville business men, W. H. Parks being one of the prime movers. This scheme, it is understood, has no connection with the present Northern Electric system, but is one promoted purely for local purposes.

Ashland, Ore.—Capt. F. L. Evans, manager of the Oregon Rapid Transit Co., a company recently organized under the laws of Arizona Territory, appeared before the Ashland Commercial Club in behalf of a project for the building of an electric railroad line through the Rogue River Valley, starting at Ashland and extending to Grants Pass, a distance of forty miles. The club will take some action in the matter.

San Francisco, Cal.—The Lagunitas Water Company, of Marin County, has decided to incur a bonded indebtedness of $2,000,000 for the construction of a water works plant and distributing system. This means the development of the large water-shed of the Berry ranch, on the northern slope of Mt. Tamalpais. When the plant is in operation it will furnish to the people of the southern part of Marin County, it is estimated, between eight and twelve million gallons of water daily.

TELEPHONE AND TELEGRAPH.

Salt Lake City, Utah.—The Rocky Mountain Bell Telephone Company has in contemplation the erection of a line from Miles City, Mont., to Billings, Mont. This line will involve the stretching of about 350 miles of wire.

San Jose, Cal.—S. J. Lisberger, engineer of electrical distribution for the California Gas & Electric Company, was in San Jose recently, examining the section of the city in which all the wires are to be laid underground.

The Department of Electricity has presented its estimates for next year's budget to the Board of Supervisors. Chief Hewitt asked for a total of $275,450.06. This sum is divided as follows: Salaries, $63,900; maintenance, $17,690; rehabilitation, $70,588.10; restoration of police signal system, $19,867.40; restoration of the overhead fire and police alarm systems, $9,844.56; underground, $93,700.

Bakersfield, Cal.—The Kern Mutual Telephone Company, which has for its object the connection of the west side oil fields with Bakersfield and long-distance phones of the Pacific Coast, has been organized, with a capital of $35,000. The officers are F. G. Munzer, president; Tim Spellacy, vice-president; Harry W. Thomas, secretary; James McGuire, treasurer; R. E. Galloway, general manager. The building of the new line will be begun immediately, and Mr. Galloway has left for McKittrick, to spend several days in preliminary arrangements. The long-distance loop will be of copper, enabling subscribers to talk to any place where there is a long-distance phone. The line will be independent. It will be 150 miles long, the main trunk lines being seventy-five miles in length. The line will place McKittrick, Midway, Sunset, and Maricopa in direct communication with Bakersfield.

TELEPHONES.

Redding, Cal.—The Northern California Power Co. are installing a private system of sixty telephones for their own use.

Steptoe, Wash.—Mayor Trowbridge has succeeded in getting plans perfected to have the Rosalia telephone line extended to Steptoe.

Tacoma, Wash.—The Inland Empire Telephone Co. will extend their system from Gig Harbor to Vashon Island, by submarine cable.

Oregon City, Ore.—The Mount Scott Telephone Company has organized for the construction of a line from Lents to Happy Hollow, over Mount Scott.

Vallejo.—The gunboat Yorktown arrived at the Mare Island yard last week. While at the yard a wireless system will be installed and some repairs will be made.

Yerington, Nev.—H. Hironymous and J. I. Wilson have formed a company for the purpose of building a telephone line connecting Yerington with Mountain View.

Cashmere, Wash.—It is reported that Colonel Huston is contemplating another telephone system for Cashmere, to compete with the Farmers' Telephone Company.

Ephrata, Wash.—The Commercial Club has appointed a committee to look into the feasibility of a telephone line to extend from High Hill through Soap Lake to this place.

Salem, Ore.—The Monitor Mutual Telephone Company has petitioned the County Court for a franchise for a telephone line from Monitor to Woodburn, McKee and Mt. Angel.

Medford, Ore.—The Pacific Telephone & Telegraph Co. have offered to sell their plant at this place to a local company for $8,000. There are 400 subscribers connected and a large number of prospective subscribers are waiting for telephones to be installed.

Wardner, Ida.—The Interstate Telephone Company will be in shape to open up its long-distance lines to Wardner, Kellogg and Wallace, by May 1. The line is now completed to a point between Kingston and Wardner.

Edmonds, Wash.—Mr. De Varney, of the B.-R. Electric Co., of Portland, has just finished the installation of a small common-battery telephone plant here, for the Edmonds Independent Telephone Co., and the system is now being placed in service and subscribers connected up.

San Francisco.—Sausalito, Mill Valley and San Rafael have been added to the list of cities on the other side of San Francisco Bay which receive telephone service by the two-number system of long distance communication. The Marin County exchanges were cut over to the new service this week.

Bellingham, Wash.—The Sunset Telephone Company will begin at once the installation of common batteries in all its Bellingham telephones, to replace the local batteries. From fifteen to twenty-five men will be employed. Manager B. F. Reno says that the work is great enough to keep twenty-five men busy about three months. The cost of labor and material will be $6,000 or $7,000.

Gooding, Ida.—Furcht & Furcht are erecting an office building on Main Street, which they will occupy as a real estate office, and will also use it as general offices for their telephone company, which has a franchise for erecting an independent line in the streets and alleys of all unincorporated towns and villages of the county, as well as the use of all the public roads of Lincoln County.

Chehalis, Wash.—R. S. Reany, who for several years past has had charge of the local telephone system of the Pacific States Company, announces that extensive improvements will be made. Mr. Reany will purchase the telephone systems in operation in Chehalis and Centralia, and will organize a company to control them. It is his intention to put in a complete and modern system in both cities.

Vancouver, B. C.—The British Columbia Telephone Company secured a recommendation that the following pole lines be constructed: Seaton Street from Burrard to Butte, Dufferin Street, Sixth Avenue, Seventh Avenue, Eighth Avenue, lane between Ninth and Tenth Avenues, lane between Tenth and Eleventh Avenues, Twelfth Avenue and Sophia Street, lane between Granville and Seymour Streets, lane between Granville and Howe Streets, lane between Howe and Hornby Streets, lane between Hornby and Burrard Streets, Hamilton Street, the lanes between Burnaby and Davie, Homer Street, underground conduits in streets, and Davie and Pendrill Streets.

WATERWORKS.

Vallejo, Cal.—Bids for the construction of the pipe line showed that J. F. Gore made the lowest tender, but his bond was a few cents shy. C. D. Vincent, the next lowest bidder, was awarded the contract for $3,874.00.

Salt Lake City, Utah.—S. M. Levy, engineer for the National Development Company, and manager of the operations of the Snyder-Loose-Wingfield syndicate in the Gold Circle district, arrived from camp last week, to purchase pipe for a water system for the town of Midas.

Oakland, Cal.—The compromise between the People's Water Company and the city, binds the water company to install a much larger system of mains in Linda Vista, in East Oakland heights and in upper Broadway, and to complete a larger storage reservoir in East Oakland.

Oakland, Cal.—The contract for installing and furnishing the pumping machinery of Oakland's salt-water system of fire protection, has been awarded to the Doak Gas Engine Company by the Board of Works. The machinery will cost a little over $25,000. The matter of providing plans for the buildings and foundation of the municipal salt-water plant, was left to John Gaylord Howard and partner, John Galloway. They will commence the work of drawing the plans at once. Eastern firms were also bidders for the pumping machinery.

San Francisco, Cal.—While the members of the Board of Supervisors and the officials of the Spring Valley Water Company were struggling to reach an agreement as to the future supply for San Francisco, City Engineer Marsden Manson, acting as the special commissioner of the municipality, was hurrying to Washington on a secret mission to secure the rights to the Hetch-Hetchy system. Every effort was made to keep Manson's departure a secret. He was granted a leave of absence quietly, and left last Tuesday morning, vested with full authority to act for the city in the negotiations in Washington.

FINANCIAL.

Bakersfield.—An assessment of 1 cent per share, delinquent May 5th, sale day May 23d, has been made on the U. S. Oil and Mining Company's stock.

San Francisco.—Assessment No. 2, of 5 cents per share, delinquent May 4th, sale day May 23d, has been levied on the stock of the Monte Cristo Oil & Development Company.

New York.—The United Railways Investment Company's $3,500,000 notes are all subscribed for. The March gross earnings of the United Railroads of San Francisco are $558,524, an increase of nearly 4 per cent over last year.

Los Angeles.—A recent meeting of the City Council authorized another issue of $240,000 aqueduct bonds of denominations of $200. This issue is designed for popular subscription and is expected to appeal to many persons who have small amounts of cash to invest safely. The bonds will bear 4 per cent interest.

San Francisco.—The Spring Valley Water Company has submitted two propositions to the representatives of the municipality—one that the city buy its entire system, except the Lake Merced property, for $28,000,000; the other that the city grant such a material increase of revenue to the company that the latter may continue in business and be able to make such needed improvements as will put off for a time, at least, the danger of a water famine. The increased revenue is to be provided, according to the suggestion of the company, by allowing the 1902 rates to private consumers to be raised by 15 per cent, by making the charge to the city for hydrants $5 each, and by allowing the company something for depreciation, the sum of $200,000 being tentatively suggested.

The annual report of the Northern California Power Company, submitted to the stockholders by President H. H. Noble at the annual meeting held in San Francisco, March 16, is as follows: "Although the past year of our company has not been as prosperous as gave promise at the beginning of the year, yet considering the financial conditions of the country we can congratulate ourselves on the very substantial gain of $82,231.90 in our gross earnings over the previous year. Had not the price of copper dropped to the very low price that it did, we would have earned at least $50,000 additional. When copper declined from 25½ cents to 11½ cents per pound, the Mountain Copper Company and Great Western Company were compelled to shut down their smelters; the Mammoth and Bully Hill Companies ceased pushing their construction work as formerly, and the Balaklala shut down after spending over $700,000 on its smelter and being within 60 days of completion.

"The company has installed in this smelter 1585 horsepower in motors, and at its mine 225 horsepower. The Trinity Copper Company also has 350 horsepower in motors installed that will be in use when the Balaklala smelter is completed. In this connection, I have just learned that the company has been financed and that work will be resumed at once. In order to take care of this increased load, we have run a second transmission line from Keswick to Kennet through Coram, about 14 miles in length, and have erected and equipped a large sub-station at Coram for the Balaklala smelter; also a sub-station at the Balaklala mine sufficiently large to take care of the Trinity Copper Company. We have extended our lines to the Sugar Loaf group for the Stauffer Chemical Company, also to Quartz Hill, and a short line to the Milton mine. Owing to the growth of our gas business in Redding we were compelled to build a new gas holder and extend mains at a cost of $11,671.31.

"At Heroult-on-the-Pitt we have put up a substation, where I expect more power will be sold than on all the rest of our system. This is due to the fact that the process of smelting iron ore by electricity has proven a commercial success, and a plant will be installed by the Noble Electric Steel Company just as fast as we can guarantee them power, and only limited in size by the amount of power we can furnish them. The electric pumping plant installed by the Central Irrigation & Canal Company was in operation throughout the summer of last year and proved an unqualified success. The Bully Hill Company will start its new smelter some time before the close of the present month.

"Of the 20 cities and towns that we furnish with light and power, all have shown a material increase, and the number of small pumping plants that have been installed is very gratifying, especially in view of the fact that we have been working on these lines for so many years. At the present time we have many applications that we cannot fill, owing to the long distance which it would be necessary to run our lines. In behalf of our Battle Creek Power Company we have purchased the Hazen property of 2,360 acres, together with water rights on South Battle Creek, which will enable us to develop 5,000 horsepower at a very low cost; also the Willows Water & Light Company, which will add very materially to our income. We have installed a complete new water system for the city of Redding, which is not equalled by any of its size in the State, consisting of a substation with 450 kilowatts in transformers, a pump house equipped with two 150-horsepower motors direct connected to two centrifugal pumps capable of pumping 3,500 gallons per minute to the reservoir.

"We have disbursed $40,000 in dividends during the past year, and reinvested $95,478.82 of our net earnings in land, water rights and extensions.

"Some ten months ago we had arranged to sell $500,000 of our Battle Creek bonds. On the strength of this sale we commenced active construction of the Horseshoe Bend plant of 12,500-horsepower capacity, made contracts for machinery, and had a large force of men at work on the dam, when the financial troubles of the country came on and the party to whom we had arranged to sell the bonds was unable to take them. We were compelled, however, to continue with our work for a number of months in order to save that which had already been done. As a result the indebtedness of the company was increased to an undesirable total, and in November of last year your directors were, reluctantly, compelled to suspend the payment of monthly dividends.

"However, the Mammoth Copper Mining Company has at last started its converters, and we can now calculate on an increase of at least $4,000 per month in its power bill. This and the blowing-in of the Bully Hill smelter will bring our net income for the coming month above $20,000. We also have a good prospect of selling our Battle Creek bonds, and this will put us in a very strong financial position and enable us to pay the accumulated dividends." Earning statements for the year ended February 29, 1908:

Gross earnings	$297,061.00
Operating expenses and fixed charges	165,098.99
Total	$131,962.91
Profit on repair work and sales of material	3,515.91
Net earnings for 12 months	$135,478.82
Dividends paid, eight of $5,000 each	40,000.00
Surplus for 12 months	$ 95,478.82
Surplus March 1, 1907	167,839.46
Surplus March 1, 1908, reinvested in land, water rights and extensions	$263,318.28

The following Board of Directors was re-elected at the annual meeting: H. H. Noble, Edward Coleman, J. Henry Meyer, C. R. Downes and A. S. Carman. After the shareholders' meeting the Board organized, re-electing H. H. Noble, president; J. Henry Coleman, vice-president; the Bank of California, treasurer; Edward Whaley, secretary; E. V. D. Johnson, manager, and W. H. Pearce, assistant secretary.

THE

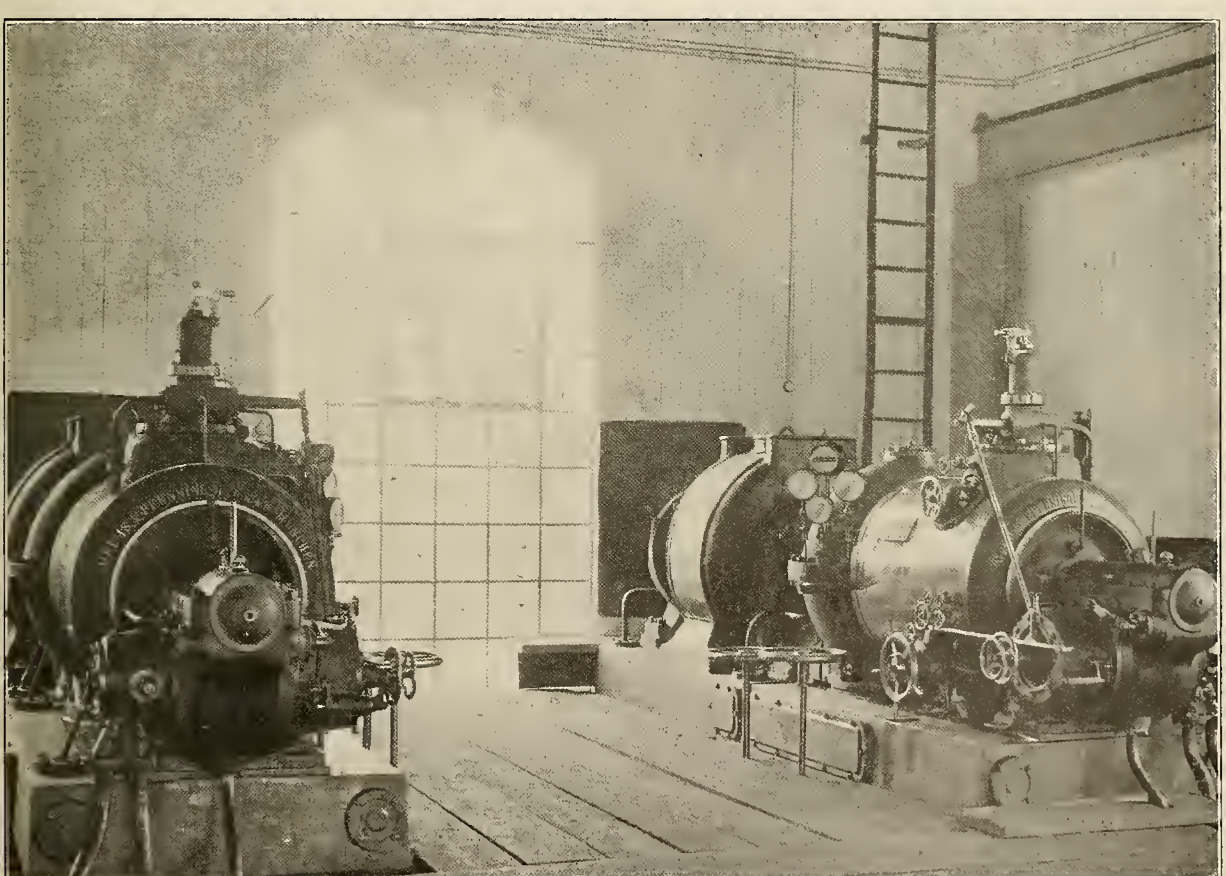
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., APRIL 25, 1908 No. 17

MODERN GERMAN STEAM TURBINE PLANTS.

It may be of interest to consider some of the latest installations of steam turbines in German power plants and central stations, as well as the construction, method of operation, and economy of these new prime movers as compared with the latest types of reciprocating engines. It is generally conceded that where additional power is found desirable, either in the central station of a large city or town or in the power plant of a large manufacturing establishment, and the space is limited, the steam turbo-generator can usually be installed to advantage on account of the small amount of space it requires. This information has been compiled by Frank C. Perkins.



STEAM TURBINE AT CENTRALE WIK, GERMAN MARINE.

At the Centrale Wik of the German Marine, two steam turbine units have recently been installed, of three hundred horsepower capacity each, as shown in the accompanying illustration. These German steam turbine sets were placed in operation in March, 1908, by Melms & Pfeniger, G. M. B. H., of Munchen. A similar unit of 1,200 horsepower capacity, driving a direct-current electrical generator, has been installed at the Elektricitats Werk Bielefeld. All of these steam turbines are of the combination action and reaction type, which has been in successful operation at the power plant of the Maffei locomotive works in Bavaria.

It will be of interest to consider the performance of the latter modern steam turbine unit of 500 kilowatts capacity, constructed at the Eisenwerk Hirschau, Munich. This German steam turbo-dynamo outfit consists of two electrical generators of a continuous-current type, directly coupled to the 1,000-horsepower steam turbine shown in the photograph.

The design of this steam turbine is based on a combination of the reaction principle for the low-pressure part and the action or impulse principle for the high-pressure end of the turbine. The fixed guide blades are arranged for the admission of steam only over a small portion of the circumference at the high-pressure end of the turbine. The

partial-admission system is therefore utilized on this portion of the turbine, and hence the diameter of the drum is made large at the high-pressure end, and there is a step-down from this section to the first part of the reaction turbine, which is of smaller diameter, and it is maintained that the annular surface thus formed enables the axial thrust of the steam due to the reaction portion to be balanced very easily.

It is also held that the adoption of the impulse principle for the steam turbine high-pressure end greatly reduces the length of the drum, and its form also reduces the cost of construction over that of the reaction turbine of usual design. It is also stated that as the casing is shorter, the difference of temperature does not give rise to the serious troubles known as "hogging," and "whipping" of the drum is also avoided, as the diameter is large. It is also claimed that the number of blades necessary is greatly reduced as compared with ordinary reaction turbine.

It may be stated that the theoretical efficiency of the reaction steam turbine is superior to that of the impulse turbine, as far as friction losses are concerned, in the absence of leakage losses, but these German engineers hold that at the high-pressure end of the reaction steam turbine this superiority does not exist, as there is a larger loss of leakage on account of the clearances required at the blade tips.

engine working at constant load and at their highest economy.

Steam turbines are used for supplementing the reciprocating engines at the Frankfort Electricity Works, which has a total capacity of 15,000 kilowatts, the boiler installation supplying steam for the turbines and reciprocating engines including twelve Kuhn internal flue boilers, with Galloway tubes, and six automatically fired Munkner water-tube boilers of the Simonis & Lanz construction, the former boilers having transverse drums and Tenbrink grates.

The ash conduit with rail track is under the boiler-house floor, and the main flue is behind the boilers, having a cross section of about four square meters. The chimney is nearly ten feet in diameter at the top, and measures 165 feet in height. The coal bunker is 120 meters long, about 39 feet wide, and 19½ feet high, and the feed water supplied from the city water works is stored in a masonry tank of 46,000 cubic feet capacity, injectors being used for feeding the hot water tanks from the storage tank.

The twelve Kuhn boilers of the internal type each have a grate surface of 925 square feet, the boilers being 28.5 feet long and 8.25 feet in diameter, with flue 4.25 feet in diameter, constructed of corrugated plates. A steam dome 3 feet in diameter and 3.95 feet high is provided on each boiler, with the necessary stop and safety valves.

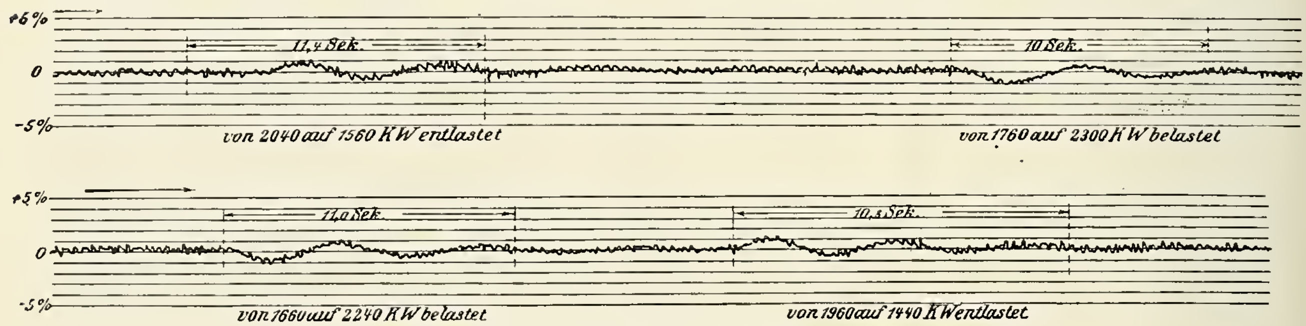


FIG. 2. SPEED VARIATION CURVES OF FRANKFORT TURBINE.

It is claimed that the adoption of the impulse system for the high-pressure end of the turbine and the reaction principle for the low-pressure end has given a combination steam turbine unit having the lowest steam consumption for a similar output which has yet been obtained.

It may be of interest to note the results of a test made by Professor Schroeter, of Munich, on this 500-kilowatt mixed type of steam turbine under various conditions of load. The two generators driven by this 1,000-horsepower Melms-Pfenninger-Sanker steam turbine each have a capacity of 250 kilowatts, and when operating under full load, supplying 500 kilowatts during the test, the speed average was 2,459 revolutions per minute, with an absolute steam pressure at the stop valve of the turbine of 191 pounds per square inch. The steam consumption was found to be 17.1 pounds per kilowatt hour, 8,570 pounds being the total steam consumption per hour. The steam pressure during this test was 176 pounds above atmosphere, while the actual temperature of the steam was 319.4 degrees C., or 607 degrees F.

The larger central stations in Germany, as well as in many other European countries, are now equipped with steam turbines as supplementary equipment to reciprocating engine units wherever additional power is required, particularly where space is limited and other conditions make the steam turbo-alternator a desirable adjunct to the plant.

The wonderful success in using these turbo-alternators in parallel with slow-speed alternators driven by reciprocating engines makes them most desirable where extra power is found necessary, due to a high peak load. The steam turbine and generator act as a great storage battery, readily supplying power far above their rated capacities during short periods. It is also noted that these high-speed units take the peak of the load automatically, leaving the slow-speed steam

These boilers supply a maximum of 60 pounds of dry steam per square meter of heating surface at 135 pounds pressure, and normally 38 pounds per square meter of heating surface. The six water-tube boilers each have a grate area of 48.5 square feet and a total heating surface of 3,340 square feet, these boilers each having two drums 20 feet long and 1.15 feet in diameter, with steam domes 2.3 feet in diameter and 2.75 feet in height.

In addition to the above boiler equipment, there are six other water-tube boilers of the Steinmuller type, each having a heating surface of 3,350 square feet, which can be utilized with or without superheaters, the latter each having a surface of 775 square feet. These boilers are equipped with electrically operated automatic stoking apparatus of the Leach type, and when the boilers are operating with superheaters give 1.85 pounds of steam, at 300 degrees C., per square foot per hour at 150 pounds steam pressure.

The power load of a modern electric station, in Europe as in America, includes not only the commercial motor service, but frequently traction service as well, the former utilizing single-phase or two or three phase motors ranging from 110 to 150 horsepower, and when direct current is available, 110-volt, 220-volt, or 500-volt continuous-current motors of about the same sizes. The traction service is usually 500-volt direct current, although the single-phase and polyphase railway systems coming into use call for current supplied to induction motors and other alternating types.

At the Frankfort Electricity Works, located on the River Maine, there are four 1,500-horsepower units and four 750-horsepower units, the generators all being of the single-phase type constructed by Brown, Boveri & Co., of Baden, Switzerland. The four 750-horsepower engines are of the tandem

compound type built at Stuttgart by G. Kuhn, and are operated at 120 pounds initial pressure and at 85 revolutions per minute, developing a normal power of 560 brake horsepower and a maximum of 750 brake horsepower.

The increased lighting load is 7,000 kilowatts, and the increased power load at this station is being taken care of by two 5,000-horsepower steam turbines of the Brown-Boveri type, directly coupled to alternators, which are driven at a speed of 1,360 revolutions per minute, the speed curves being seen in Fig. 2. These steam turbines work with superheated steam at 300 degrees C. and at 135 pounds, supplementing the 750-horsepower reciprocating steam engines above referred to, as well as the four 1,500-horsepower reciprocating engines of the Sulzer type, operating at 85 revolutions per minute.

Steam turbines are now finding a special field in increasing the capacity of stations, by using the exhaust steam from large reciprocating engines and working under a vacuum when plenty of condensing water is available. The capacity of a station can be readily increased by their use, even where but limited floor space is available.

At the Frankfort station the engine room measures 75 feet by 282 feet, its height being 34 feet from the floor to the eaves, and the boiler room is 395 feet long and 59 feet wide.

The largest engines when tested showed a steam consumption of 14 pounds with a load of 1,408 brake horsepower, and at about three-fourths and one-half load of 1,073 horsepower and 705 horsepower; the steam consumption was 13.85 pounds and 13.55 pounds per indicated horsepower per hour.

As a result of tests at the Frankfort steam turbine installation, with a steam pressure of 10.6 atmospheres and steam superheated to a temperature of 312 C. the steam consumption was found to be 14.75 pounds per effective kilowatt-hour with a load of 2,995 kilowatts. This 5,000-horsepower steam turbine was guaranteed to drive the alternators at an output of 2,600 kilowatts on a steam consumption of 15.9 pounds per e. kilowatt-hour, with a steam pressure of 12.8 atmospheres and 300 degrees C. superheat. On a test it was found that the unit when operating at a load of 1,945 kilowatts and supplying with steam at a pressure of 12.63 atmospheres and 2.98 degrees C. superheat, the steam consumption was 15.9 pounds when the load was increased to 2,518 kilowatts, the steam pressure being 12.8 atmospheres and the superheated steam having a temperature of 295 degrees C. There is every reason to believe that the future has much in store for the steam turbine for the generation of electric power on account of its economy of operation, small amount of space required, and low cost of construction for the electrical generator to which it is directly connected.

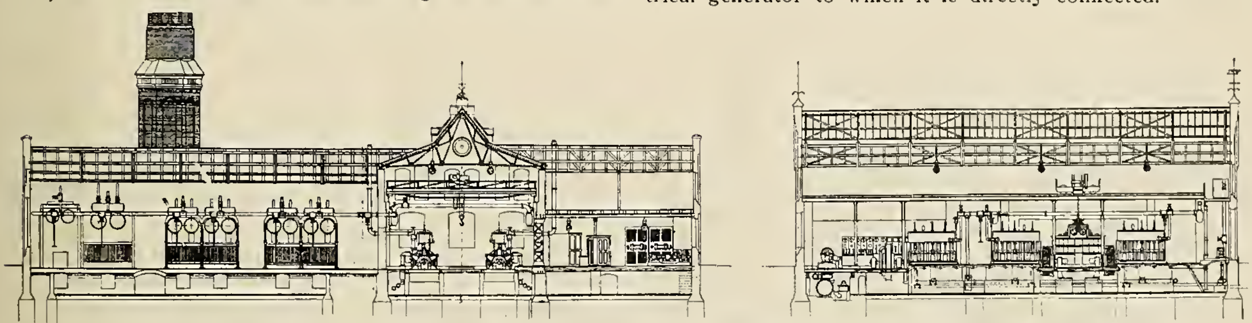


FIG. 3. ONE TURBINE SET SUPPLEMENTING SIX RECIPROCATING ENGINES AT ZENTRALE I, BREMEN, GERMANY.

In the basement of the engine room there is a steam collector taking steam from the twelve flue boilers, which is made in two sections, with a copper bend, the diameter of the collector being 2.08 feet, and valves are provided so that each section can be shut off separately when desired.

The ring system of the steam piping is used for the water-tube boilers instead of collectors, this piping, however, communicating with the collectors at convenient points, steam-drying apparatus being inserted and the valves installed so that each engine and each boiler can be disconnected from the main steam pipe at will.

The 750-horsepower engines of the Kuhn type are fitted with Kuchenbecker valve gear and may be operated as non-condensing engines or condensing engines, as desired.

These engines have a stroke of 3.96 feet, and high-pressure and low-pressure cylinders, measuring 2.08 feet and 3.16 feet in diameter respectively. These engines measure 4.85 feet and 8.1 feet between bearings, and have a length of 3.04 feet from the end of the cylinders to the center of the crank shaft. The fly-wheel weighs 56,000 pounds, and is nearly 16.5 feet in diameter.

The 1,500-horsepower Sulzer engines have fly-wheels weighing 100,000 pounds, and are over 20 feet in diameter, with cylinders 3.22 feet and 4.13 feet in diameter respectively for the high and low pressures, the stroke being 4.95 feet in length. These engines are about 43 feet long, with bearings about 12.5 feet apart.

The steam consumption of the 750-horsepower engines during tests was found to be 15.4 pounds per indicated horsepower of 578 brake horsepower, while the consumption of the steam increases to 15.8 pounds per indicated horsepower per hour with a load of 760 brake horsepower.

The steam-consumption curves for the Frankfort steam turbine at 10 atmospheres pressure and 230 degrees C. and 300 degrees C. show a variation from somewhat above 22 pounds at 500 kilowatts to 16.8 pounds at 3,000 kilowatts. With a steam pressure of 14 atmospheres, varied from less than 10 kilograms at a trifle over 500 kilowatts load to as low as 14.6 pounds with an output of 3,000 kilowatts.

Many of the most important central stations in Germany, as well as in France, are now being equipped with steam turbines direct connected to alternating-current as well as direct-current dynamos, these turbine units being employed for supplementing the reciprocating steam engine sets of the slow-speed type.

Such an equipment is shown in the accompanying drawing (Fig. 3) of Zentrale I, or the main station on Schlachthofstrasse, in the city of Bremen, Germany.

Six of the vertical slow-speed engine sets are supplemented by the Parsons steam turbine, Brown, Boveri & Co., of Baden, Switzerland. This horizontal steam turbine has a capacity of 750 horsepower and operates at a speed of 2,100 revolutions per minute. It is directly coupled to two direct-current dynamos of 500 kilowatts for electric lighting and railway service.

The advantages of steam turbines as supplementary equipments are many. They occupy small space for a given output, and this is important in adding additional units where space for increased capacity of the plant is limited. They take care of variable loads with great satisfaction, and are capable of being overloaded for a short period of time at the peak of the load without injury. The steam turbines in taking up the variations in load similar to a storage battery allow the reciprocating slow-speed steam engine sets to

operate at constant load, therefore working with the highest economy at their maximum output.

Four of the vertical triple-expansion engines in this station are of the Schichau type, developing 320 horsepower at 120 revolutions per minute. They are each directly coupled to Siemens & Halske inner-pole type direct-current dynamos for lighting service.

The other two units are of the same type of engines, developing 380 horsepower each, and directly coupled to direct-current machines supplied by the Union Elektrizitats Gesellschaft.

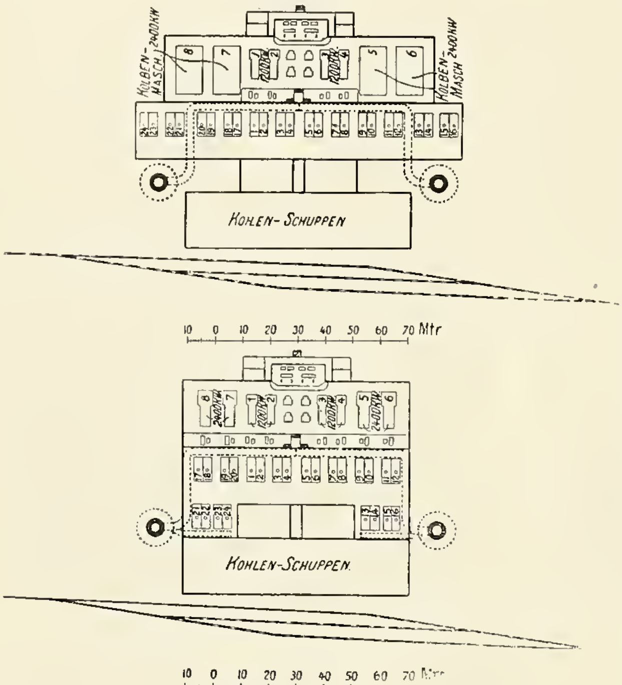


FIG. 4. ZENTRALE II, BREMEN, GERMANY.

This station has a total capacity of about 3,000 kilowatts, and it is provided with an accumulator plant consisting of two sets of 68 cells of storage battery, each having a capacity of 140 amperes discharge rate for three hours, for lighting service. There are 267 cells of battery provided for electric railway service, each having a capacity of 780 amperes discharge rate for one hour, the complete battery having a capacity of 130 kilowatts, with a three-hour discharge rate.

The new station of the Stadtischen Elektrizitats Werks, Bremen, equipped with a steam turbine exclusively, is shown in the accompanying drawing. The Zendrale II at Kastedt is equipped with 8 boilers, each having a heating surface of 300 square meters and supplying steam at a pressure of 12 atmospheres to the steam turbines, superheaters being provided for raising the temperature of the steam to 350 degrees C.

The steam turbine and generator room, as shown in the accompanying drawing, is equipped with 4 turbo-dynamos of the Zoelly type, constructed by Ecchers, Wyss & Co., of Zurich, Switzerland. These turbines each have a capacity of 1,200 kilowatts, driving three-phase alternators of this output constructed by the Siemens-Schuckert-Werk, of Berlin. The turbines operate at a speed of 1,500 revolutions per minute, and the Drehstrom dynamos supply a current of 7,500 volts pressure.

These turbo-alternator units have a total normal output of about 5,000 kilowatts. In order to show the difference in space required for steam turbine units as compared to reciprocating units for increasing the capacity of this plant to 14,400 kilowatts, it will be of interest to examine the accompanying drawings (Figs. 6 and 7), showing an addition of four sets of 2,400 kilowatts each, while the arrangement requires a much greater area for four vertical reciprocating engine sets of the same capacity.

In the center of the engine room of Central Station 11 at Bremen will be noted four rotary transformers or motor generator sets, of 100-kilowatt capacity each, for use in charging storage batteries located in the basement of the station under the switchboard equipment.

There is a unique and interesting sub-station and storage-battery plant at Grossen Hudestrasse, in Bremen, which is provided with three storage-battery installations, one having a capacity of 406 kilowatts, there being 138 cells, with a discharge rate of 1,584 amperes for three hours. There is another set of 138 cells, with an output of 318 kilowatts, or 1,242 amperes, while the third set consists of 144 cells of 260 kilowatts capacity, supplying a current of 972 amperes. The first two battery sets were installed by the Akkumulatorenfabrik A.-G., while the third battery was supplied by the Pfluger Akkumulatorenwerke A.-G.

In this sub-station there are three motor generator sets of 600 kilowatts capacity and three similar sets of 400 kilowatts output. Near the storage-battery installation there are two motor generator sets of 60 kilowatts and one of 110 kilowatts, these sets consisting of three machines operating on a common shaft for use in charging the storage-battery plants. The current is received at this sub-station as a three-phase alternating current at 7,500 volts, and is transformed by the motor generator sets to a direct current, with the storage-battery plants for regulation and for reserved power in taking care of the peak of the load.

MEXICAN TELEPHONE ENTERPRISE.

The following details of the first concession for wireless and long-distance telephone service in Mexico, forwarded by Special Agent A. B. Butman, are from the Mexican "Herald": The company, which is being formed with a capital of $1,000, 000 Mexican currency ($500,000 American) to develop long-distance and wireless telephony between Mexico City and the port of Vera Cruz, is now being completed. The company is being organized through the efforts of Lic. Francisco Alfaro, who represents capitalists of London who are anxious to further the development of such an enterprise.

The concession for the establishing of long-distance as well as wireless stations in the section of the Republic between this capital and Vera Cruz has been obtained by Manuel S. de Corbera and Engineer J. Sitzenstatter, covering a period of fifty years, and including the building of lines in and between various towns, such as Vera Cruz, Cordoba, and Orizaba. In these towns underground cables and lines will be laid, over 5 kilometers (kilometer, .62 mile) of underground work having been laid already in the port of Vera Cruz. The wireless part of the concession will be developed later, the concessionaires now putting their attention to the stringing of wires between towns and the laying of underground cables in Vera Cruz. It is the ultimate intention to spread a network of wires throughout the State of Vera Cruz for the purpose of connecting the large rubber, coffee, sugar, and other plantations of that State with their center, their commercial district, Vera Cruz. Governor Teodoro A. Dehesa and his secretary of state, Lic. Eliezer Espinosa, are very greatly interested in the construction of adequate telephonic service as planned by the concessionaires, and the President of Mexico, General Porfirio Diaz, is assisting this important enterprise with many suggestions.

SINGLE PHASE RAILWAY.

San Francisco, Vallejo & Napa Valley Railroad.

(Concluded.)

Discussion by H. W. Crozier.

While discussing the present condition of this railroad, it may be of some interest to look into some of the difficulties which have been encountered and overcome. Their lessons may be of value in discussing new roads, and they surely exposed all the weak points of the motor.

In looking over the first six months of operation on this road, I am reminded of a lecture I heard many years ago. In discussing the d. c. railway motor, the lecturer took occasion to state that its principal development was in its mechanical construction. Our experience has been similiar with the alternating current motor. Most of its troubles were due to the failure of apparatus which had not been fully developed, and was not ample for the service to be performed. There were, of course, certain electrical features which, while not in themselves wrong, were unsatisfactory for the purpose. Our principal difficulties were with the mechanical operation of the apparatus.

The road extends from Vallejo to Napa, there being sixteen miles of track laid with sixty-pound rail on redwood ties, using dirt ballast. There was a small amount of gravel ballast at some points.

The overhead construction was similar to ordinary d. c. practice, and was supplied with 750 volts alternating current by five transformers, located at approximately equal distances. A 6600 volt transmission line of No. 2 copper fed the transformers. The track was bonded with 4/0 plastic bonds.

The station equipment consisted of two 400 kilowatt two-phase generators, mounted on the same shaft, with three-phase induction motors, which were furnished with power from the Bay Counties Power Co.

A Tirrill regulator took care of the violent voltage fluctuations in a very satisfactory manner.

The generators being wound for 6600 volts, fed directly to the transmission line. The station machinery operated nicely and required but little attention.

The alternating current motor in itself gave us very little trouble, but was so hedged around with apparatus that either limited the current supply or would not operate satisfactorily, that the alternating current motor did not get a fair show. Of course, the motor was the new and the supposedly experimental thing, and it had to bear on its weak shoulders all the defects of its auxiliaries and their failures.

A word as to the motor, and later we will discuss the auxiliaries. We used to cuss them.

You are all undoubtedly familiar with the general construction of the motor. It is very similar in design and in operation to a d. c. series motor, with commutating poles, and operates almost the same. The armature has a d. c. winding of the usual form, with the addition of German silver resistance leads running from the ends of the winding to the commutator. The commutator is on what is usually designated the back end of the armature, and the resistance leads are taken through the armature core in the bottom of the slots. The office of these resistance leads is to limit the flow of current in the coils short-circuited by the brushes. There are four groups of brushes, which are made as narrow as possible.

The field is made up of punchings, and is of the four-pole type. There is in addition to the winding on the pole pieces, a second winding distributed in slots in the pole faces, and arranged so as to have its magnetizing effect forty-five mechanical degrees behind the main poles or in the space between them. This second winding, called the compensating winding, is permanently connected in series, with the brushes and the armature, and is reversed when the armature is reversed.

The motors operated generally satisfactorily, and while their torque in the earlier operation of the road was quite defective, it improved as the conditions improved. Sparking, supposed to be the great bugbear, was almost imperceptible, and never at any time gave us any trouble. The commutators operated beautifully, as far as commutation and other such matters were concerned. Mechanically, however, they were weak, being made up with fish paper between the bars. Under the influence of the considerable temperature which the commutators would attain, and also the high velocity at which they were run, they failed after about two or three months' service by throwing the fish paper out from between the bars.

The resistance leads would also burn off at various times, but I ascribe this trouble as due to the low voltage which was applied to the motors, causing them to start very slowly. If the car did not start promptly, a very considerable current would flow in the German silver leads and they would fail.

A peculiar feature of this motor was the fact that it would run right along with a dozen or so resistance leads burned off, and we would know nothing of the matter until the inspector would find the defect at night. The re-winding was difficult, and attempts at re-winding made in San Francisco were unsuccessful. Usually armatures re-wound would fail by bursting the bands, until satisfactory band-wire could be obtained from the factory.

In addition to the motors, the car equipment consisted of the following auxiliaries: A transformer, a circuit-breaker, a reverser, an induction-regulator, an air pump and transformer, two master controllers, and a seven cell storage battery. The power-circuit from the trolley went directly through a fuse to the circuit-breaker, and a tap was taken off for the air pump transformer, which also supplied current for the lights.

The circuit-breaker, reverser and induction regulator were operated by compressed air, distributed by magnetically operated valves, electrically connected to the controller, and so interlocked that each performed its functions at the proper time. The induction regulator was fitted with a complete three cylinder air engine, controlled by two air-operated slide valves, in turn controlled by the magnet valves. As for the circuit-breaker, suffice it to say that it was fearfully and wonderfully made, and that it would do nearly everything else but circuit-break.

The power supply to the motors was taken off a 210 volt tap in the transformer winding, and was conducted through the secondary of the induction regulator to the reverser, and thence to the motors. The induction regulator added or subtracted fifty volts, depending on its position, and the motors received 160 volts at start and 260 volts at highest point.

The general operating of this auxiliary apparatus was unsatisfactory from start, until it was replaced by better. The circuit-breaker gave out completely on the first trial, and was finally doctored up by completely swathing all the parts with asbestos, so that it could not burn up. By replacing the asbestos, we made the circuit-breakers operate after a fashion. The induction regulator valves had a bad habit of sticking when least expected, and would leave the car stranded on account of the interlocking, leaving the control circuit open. The air motor consumed a large quantity of air, and kept the pump working hard nearly all the time. The reverser would stick occasionally, so as to keep every one guessing. Fortunately, these things would occur one after the other, so that we had a chance to think out remedies, but they occurred frequently enough to keep everybody on the jump all the time.

About June 1st, the locomotive was tried out, and after getting all the motors to run the same way, was taken out on the road. The circuit-breaker promptly burned out, and we got home by a judicious use of the trolley rope. An oil switch, taken from the switchboard, was put on the locomotive temporarily, and the circuit-breaker repaired. The motors only

exerted a small amount of starting torque. This was due to the fact that the gears were of quite small ratio. New gears were sent by express, and after their arrival the locomotive did much better, and was able to climb the seven per cent grade in Vallejo. One of the transformers near Vallejo was found to be too far from this seven per cent grade, and it was moved to a lot in town at the head of the grade.

By this time the first of the passenger cars was ready, and on the 4th of July operations were started, using one passenger coach, and the locomotive and the trailer. Everything went along satisfactorily until about 2 P. M., when the air hose, which is inserted between the air pump and the car piping, melted off on both the passenger car and the locomotive at about the same time. This was partly due to the high temperature and partly due to the continuous work the motor had to do. As the controllers were operated by air, this put the road completely out of business. We had taken the precaution to send a mechanic to Vallejo, and with the assistance of another air hose purloined from a freight car, the locomotive was fixed up again, and similar repairs made to the passenger car. As soon as possible the cars were run into the shop and pieces of pipe put in place in the hose.

Operations were continued, the other cars were equipped and put into service, but it was not long before the locomotive threw all the paper out of its commutators one Sunday afternoon. This was caused by the commutators getting hot, but principally by the high speed at which the locomotives were run. Ordinarily, the locomotive would get along all right during the week, but when put on a passenger run on Sunday with a trailer and run on the passenger schedule, at high speed, the commutators failed.

As a usual thing the road would operate nicely throughout the week, but we would usually have something happen on Sunday. One of the principal troubles was due to hauling trailers with the passenger cars. Nearly every time this was done, a circuit-breaker would burn up on a hill and stall the car until repairs could be made or a new circuit-breaker put upon the car.

It is undoubtedly true that we would not have been able to keep the road in operation if it had not been for the exceptionally experienced and capable motormen and conductors who were brought up from the Pacific Electric Railway of Los Angeles. These men learned their cars very quickly, and were able to start off sticking valves or stuck circuit-breakers with very little delay. I do not remember of a single case of a man being caught twice by the same thing. One thing that bothered them a great deal was the fact that the lights were taken off the same transformer as the air pump. If the transformer fuse should fail, the chances are that between the large amount of air used by the induction regulator and the amount used to set the brakes, that the pressure would be considerably reduced, so that the controller would be inoperative. With the controller inoperative and no lights, the motorman would naturally conclude that the juice was off, and would sit around and wait, without thinking of investigating the air pump fuse. As I said before, no motorman was caught more than once. There was always something new happening, and it kept us on the jump to get up remedies so as to keep ahead.

After about five months, new control devices arrived from the factory and were installed on the cars, with a great reduction of the trouble account. The new devices consisted of a set of unit switches arranged to connect the motors successively to different taps from the transformer, the transformer being connected to the line all the time. This control was operated with alternating current magnets on the air valves, the compressed air doing the work of moving the contacts. The cars operated very much better with this controller, and the motors were for the first time given a chance to show what they could do.

I ascribe most of this improvement to the fact that the induction regulator was done away with. This device undoubtedly had a great influence in keeping the power factor low, as all the current to the motors had to flow through it.

A great deal has been said about the fact that the road had been equipped with 700 volts trolley, and that this was the cause of much of the difficulties. I do not agree in this, because of the great improvement in the operation of the cars when provided with the different control system, and ascribe most of the difficulty to the use of the induction regulator. The cars with the new control device could be started on any hill on the road, which was something which could not be done before.

Later, the trolley voltage was raised to 3000 volts, and this is now in operation, but the change from the first control device to the second made a much greater improvement than the change from 700 volts to 3000.

Mention has been made that the gears were changed during the very first period of operation. This was due to the fact that the motors would not climb hills at all, and would start the cars very slowly on level.

The original specifications for this road called for three quadruple equipments equivalent to Westinghouse No. 76 motor, which is seventy-five horse-power, and two equipments equivalent to Westinghouse No. 38 B, which is fifty horse-power, nearly.

Motor curves were submitted and the armature speed proposed was considered excessive by the consulting engineer. It was then proposed that means be taken to reduce this speed, and the matter was referred to the factory. The factory proposed that the next size motor be used and operated at a slower speed, using properly proportioned gears, and an additional payment of $3,000 was agreed upon for this feature.

The motors thus furnished were normally 100 horse-power and were geared low so as to be called on for nominally seventy-five horse-power only, but the gear change makes them now 100 horse-power. The question now comes up, Does it take a 100 horse-power a. c. motor to do the same work as a seventy-five horse-power d. c. motor, because equal cars equipped with seventy-five d. c. motors are doing all that these cars can do.

The writer feels that the alternating current motor has made a good showing on this road, even when hedged around with a defective controller and an insufficient voltage supply, but even with all the improvements now made, what size is it? Do we have to buy a 100 horse-power a. c. motor to do the work of a seventy-five horse-power d. c. motor, because the a. c. motor has to carry a transformer along with it? The d. c. cars referred to weigh not to exceed thirty tons, and these cars weigh at least thirty-four tons. The additional four tons is quite an item, as it has to be carried all the time, and power is required to do so.

The alternating current motor does not exert a very powerful torque at starting, and we found that if we could get the motor to turn the wheels once, that we were all right. The motors would then accelerate nicely. The very first part of the start, however, is the weak point, and reminds one very much of the action of a single phase induction motor with shaded poles.

Another point about the motor is the presence of the resistance leads. It is essential that the starts be made promptly, and this point should be impressed on the motormen, as a considerable current flows in these resistance leads, due to the short-circuiting effect of the brushes. This point is very important in freight work, where it is necessary to start heavy trains.

With improved voltage and control, all these points become of less importance, but a knowledge of these limitations is of value. In handling heavy freight trains over bad places in the track or in starting, no particular harm is done if a d. c. locomotive should stall, provided the resistances are ample, but with this motor, steps should be immediately taken to see that the current is shut off promptly, or the resistance leads will get overheated.

Discussion by A. H. Babcock.

In the "Proceedings" for March, 1907, under the discussion of the Stilwell-Putnam paper, were published some operating costs as taken from the station log at Napa. These figures, although their accuracy was not disputed, were not taken as representing fair operating conditions.

In his criticism of them, Mr. Renshaw said that the load factor was necessarily very low, and that the polyphase generators in use at that time were not adapted for supplying single phase current; that when they were re-wound, operating conditions, especially in the conversion losses, would be improved.

In my published figures at that time, I showed that the cost of power per car mile was 6.92 cents, with three passenger cars and two work cars in operation. The records taken by the committee over the month of November, 1907, show a cost for power of 7.07 cents per car mile, with five cars and a locomotive in service. The efficiency of conversion from three-phase to single phase is 59.6 per cent.

In the period from March 1st to 13th, 1908, inclusive, the committee's figures show 7.32 cents per car mile for power, with eight cars and a locomotive in service, and an efficiency of conversion of 66 per cent. Apparently, then, the power costs per car mile increase with the load factor. At any time they are approximately double what they should be.

The motor-generators have been re-wound to supply single phase current.

In the curve showing the average kilowatt readings, taken on car No. 46, over one cycle from six hours, thirty-four minutes, fifteen seconds, to six hours, thirty-five minutes, twenty-seconds, the K. V. A. are given as well as the kilowatt readings.

Under the starting conditions, with sixty-five kilowatt input to the motors at 0.38 power factor, and 2720 volts at the motor, the line drop was 1103 volts, and the line energy loss, 69.5 kilowatts, or 51.7 per cent. Possibly this excessive line loss explains why the energy costs increase with the load factor.

Under running conditions at about six hours, thirty-five minutes, there was a line drop of 363 volts, an energy loss of 30.3 kilowatts on an input of 245 kilowatts to the motors, or 11.7 per cent energy loss on the line. The power factor at the car was then 0.931.

Averaged over the entire cycle named, the line drop is 483 volts, the averaged line loss 42.6 kilowatts, with an energy input of 218.2 kilowatts, or an energy loss of 16.3 per cent.

I am pleased to note in the figures of the committee a complete corroboration of the data as published by me in the "Proceedings" for March, 1907.

The results from the committee's figures, as stated above, are striking in more than one particular; in fact, the extraordinary conclusions which may be drawn legitimately from the committee's observations are so wholly obvious to thinking minds that further comment would be unnecessary, were it not that many of us, by reason either of lack of opportunity for investigation or absence of special training, are incapable of forming independent judgments, and ready-made opinions are easily absorbed. Many others naturally follow the majority, influenced largely, in many cases, by no deeper considerations than a desire to be up-to-date, and a dislike to be considered over-conservative.

For about four years the single phase railway system has been pushed actively into public notice. Engineers who have declined to experiment with it have been condemned as lacking in courage and in progressive spirit. In some cases, where the manufacturers have had the ear of those in control, they have secured the appointment of engineers more amenable to factory influence. Naturally one is apt to favor his friends.

Let those who have to make the decision as to how large amounts of other people's money are to be invested do little talking and much thinking. Quietly, and without the manufacturers' assistance, let them investigate the financial condition, business standing, and most important, the business and financial affiliations of those in control of properties around about which so much clamor has been raised. Let them search, not for the woman, but for him who really pays the bills. Then will become evident the reasons for "the results exceed our expectations" (a statement without meaning, unless the expectations are clearly specified), and the orders for additional equipments, so loudly announced. Above all, let them get at the cold facts as shown by the operating balance sheet, and see to it that all fixed charges are properly included. Here is the final test, always—does it pay; are the net earnings written in black or red ink.

It is my belief, based on several special investigations and much data accumulated over the entire country, that investigations of this kind, made thoroughly and without bias or pre-judgment, will show beyond a reasonable doubt, that while the single phase method of traction has a promising future and a very wide application when fully developed, he who buys it today deals in futures. Gambling always is unsafe. To play the other fellow's game, with someone else's money, is a breach of trust.

Discussion by Wm. F. Lamme.

Referring to the question of starting torque, there is a prevailing impression that the alternating current series motor will not deliver as much starting torque as the direct current motor. This is an error. Just as much starting torque can be secured from the alternating current series railway motor as from the direct current, but in order to secure this, a correspondingly large voltage should be applied. For example, if the power factory at start is 40 per cent and we apply 100 volts direct current to a motor, we will secure a certain torque. If the same torque is to be secured with alternating current, we must apply, not 100 volts alternating, but 250 volts alternating, that is 100 divided by 40 per cent, the power factor. Similarly, if we apply 200 volts direct current, we must apply 500 volts alternating current to get the same torque, and if we apply 400 volts direct current, we must apply 1,000 volts alternating current.

Please note that with a transformer upon the car, any tap necessary up to 3,000 volts can be applied to the alternating current motor, whereas with the direct current, we are limited to 500 volts. That is, with alternating current it is possible to secure a more rapid acceleration than with the direct current. Because we have not yet done this, it is no reason that it cannot be secured.

These remarks are given to refute the statements made that the alternating current motor cannot give the acceleration that is secured by use of the direct current motor.

As to the drop in voltage noted at one point in the curve, part of this drop can be accounted for by the ratio of transformation.

The voltage measurement was secured by taking a tap out of the working transformer upon the car, and this tap is upon the side of the transformer to which the motor is attached. This side of the transformer is worked the hardest, therefore it is not positively certain that the ratio of transformation is not increased and the voltage measurement is lower than the actual line voltage.

You note in the paper presented tonight, it is stated, that the generators of the motor generator sets were re-wound so as to deliver single-phase instead of two-phase. This means that the iron of the generator is not sufficient, and when a heavy load and very poor power factor is thrown upon one of these generators, the voltage drops, say from 110 volts on the voltmeter to 90 volts. This, I think, is the point at which the greater drop of voltage takes place. There is no reason to believe that the voltage drop, due to the line ever exceeds 600 volts. All of this drop is not energy drop. The ratio of total drop to energy drop is 1.7—1.8 to 1, so if the voltage drop is, say, 600, the energy drop is only 350.

MANUFACTURERS AT CATALINA ISLAND.

On Saturday, April 11th, the "Owl," the fastest train of the Southern Pacific Company, pulled out of the Oakland mole on one of the most important missions ever undertaken by that road. It involved the transportation from Oakland to Los Angeles of a merry party of Sons of Jove, all of them electrical manufacturers and jobbers, bent on a pleasure trip to Los Angeles and Catalina Island. That they missed their connection for Catalina Island at Los Angeles should not be considered a reflection on the Southern Pacific system, but must be laid entirely to an unruly box car which had left the track at a point near Saugus, necessitating the side-tracking of the entire party for several hours.

It is very probable that the party would still be side-tracked had it not been for the ingenuity displayed by Dr. H. C. Thaxter, who promptly supplied blue prints and specifications, the use of which resulted in returning the car to its original position on the track, releasing the side-tracked Owl and making it possible to continue the journey. As a result of this very successful piece of work, the doctor was appropriately decorated with California wild flowers, and given the additional title of Director-General and Chief Wrecker of the party, with full authority to handle all wrecks which might occur during the balance of the trip. For the time being, Director-General Thaxter was the cynosure of all eyes. Numerous women on the train requested introductions, and the arrival of the fleet was temporarily forgotten.

The party arrived in Los Angeles at about eleven a. m., and were met at the Arcade Depot by the Los Angeles Reception Committee, who promptly took them in charge, placed them in waiting automobiles and whirled them to the Jonathan Club, where, after removing the signs of travel, a preliminary discussion of certain subjects was held in the buffet, followed immediately by an informal luncheon. After luncheon, which was heartily enjoyed by all, a special car of the Pacific system took the entire party to Long Beach, where they registered for the night at the new Hotel Virginia, recently opened, and one of the handsomest in Southern California.

It being Palm Sunday, the afternoon and evening were devoted to such quiet pleasures as strolls upon the beach, discussions of Lenten matters, and various kinds of meditations on such thoughts as naturally arise during Lent. Before dinner Mr. Carter conducted the entire party to the bathing pavilion, where they were all refreshed by a dip in the surf. The dinner in the evening, while being simple and without ceremony, was thoroughly enjoyed by all, a separate table having been arranged for the party uniquely decorated with flowers and miniature incandescent lamps, an appropriate setting for a party of this character.

The host, Mr. D. M. Linnard, of the Hotel Virginia, took special pains to make the brief visit of the party a thoroughly enjoyable one, and his thoughtfulness and courtesy were greatly appreciated by all.

On Monday morning the party took the train for San Pedro. At this point began a most enjoyable outing, which rewarded the mystic members of the Rejuvenated Sons of Jove for their lengthy journeys from Seattle, San Francisco, and other Pacific cities, to the quiet waters of Catalina.

AVALON, CATALINA ISLAND, WHERE THEY MET.

The Sons from the north were met by the Los Angeles Joves at San Pedro, where the well equipped "Cabrillo" glided across the channel, sowing the flying fish on its way, to the peaceful harbor of Avalon. The voyage was enlivened by songs which welled from the hearts of those poetically inclined, and the melody of "We're Here Because We're Here," floated o'er the waters, to drive dull care away.

"Rus"—Rus Holabird, we mean, of course—who was Southern California's father to the gay clans, pointed the way to the headquarters at Hotel Metropole, which suddenly partook of the tone and life of the party from basement to casement on high.

As the evening paced on to eight o'clock, the banquet hall was opened, showing covers laid for the twenty and four guests who found at their plates most original and attractive menu cards, consisting of enclosed fuses emptied of their original contents and now containing a springed curtain with a legend of the feast to follow. On the outside the label "Feed Fuse" had been substituted for the customary one.

And until almost the midnight hour the flow of song, good-fellowship and other things drove care into hiding for many a day.

Allusion is made only as a matter of contrast to the sixteen errors in a certain baseball game at Monterey, for our genial toastmaster, Mr. Scribner made no errors at all during the enjoyable feast, showing his proficiency in the higher things of life; for many pleasant stories and toasts were suggested, and repartee in song and story betwixt the two ends of the table was both witty and hearty.

Mr. Elliott, in a more serious vein, spoke with feeling of the advantage of these outings, in eliminating the personal element in competition between those engaged in similar lines, and establishing peace and good will in a friendly business rivalry.

THE BUNCH.

THE BANQUET.

Among those absent were everybody except the following;

E. M. Scribner, of the Western Electric Company.

T. E. Bibbins, representing the General Electric Company.

Wm. S. Goodwin, of the Sterling Electric Company.

Walter M. Fagan, representing the Telephone and Electric Equipment Company.

B. W. Smith, of the American Steel and Wire Company.

Samuel W. Gilman and J. N. Clokitt, representing the J. A. Roebling's Sons Company.

H. V. Carter, from the Pacific Electric Works.

F. E. Corwin, representing the Bryant and Perkins Company.

Messrs. Chas. W. Scott and W. R. Greene, of the H. W. Johns-Manville Company.

Chas. C. Hudson, representing the Holabird-Reynolds Electric Company.

Albert H. Elliott, representing the National Electric Trades Credit Association.

R. D. Holabird, President of the Holabird-Reynolds Electric Company.

Frank Fowden, of the Brooks-Follis Electric Corporation.

E. N. Fobes, from the E. N. Fobes Co., Seattle.

G. A. Knocke, of Dunham, Carrigan & Hayden.

Clem A. Copeland, representing the "Journal of Electricity, Power and Gas."

H. C. Thaxter, of the Standard Electric Company.

C. L. Gilson, representing the Crescent Electric Company, of Oakland.

H. G. Aylesworth, manufacturers' agent.

"BUTTON-AIRS" AND OTHERS, SMILES AND ALBICORE.

H. A. Sayles, representing the Holabird-Reynolds-Sayles Company.

C. C. Hillis, Treasurer and General Manager of the Electric Appliance Company.

Many arose early the next morning, notwithstanding the previous evening's festivities, to take advantage of the fishing afforded only by Catalina waters, and for which enthusiasts come from far away points of this and other countries.

And now we approach an event of island history which can be but faintly described, for how can we portray the gentle gradation of enthusiasm from indifference and even coolness towards the sport, to the proud moment of enthusiasm when Mr. Elliott landed his maiden albicore of 30 pounds in weight with a 9-ounce rod and a 9-thread line.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX APRIL 25, 1908 No. 17

EDITORIAL.

THE CHELSEA FIRE.

Many of the people of Chelsea, Mass., have been made homeless and their business and public utilities rendered inoperative by a disastrous fire. We of San Francisco, who know the terrors and hardships of such a great conflagration, can fully sympathize with them in their trouble. Not until we experience such a disaster do we realize how closely interwoven are our own lives with those of our fellows. Particularly is this true of a great fire which wipes out millions of dollars from the grand total of the world's improvements. These losses are the more regrettable, because, in general, they might be prevented by suitable precautions. Too often have the origin of these fires been unjustly ascribed to electricity, but in this case the electric lighting, traction, telephone and manufacturing interests were among the heaviest losers. The commendable foresight of some of the latter had provided a reserve set of machinery, which can be put into operation so soon that it will delay their productions but a few weeks, readily tided over by large stocks on hand in their outlying warehouses.

But even such foresight is not enough to compensate for great fire losses, for whose diminishment every public energy should have been directed. But as the deed is done, its remedy is what should now engross our attention. Having suffered ourselves, we understand the difficulties and appreciate the efforts of these stricken people to re-establish their homes and industries.

The "Journal of Electricity, Power and Gas" feels most deeply for them and offers its columns freely for notifying the world of their temporary locations and recording the work of re-building even a greater city. May all obstacles to progress be met by the indomitable spirit, which sees in great difficulties only a greater incentive to overcome them.

POLES.

Repeated warnings from the Forest Service regarding the rapid destruction of our available timber have caused pole users to cast about for a suitable substitute or preservative. In 1906 the telegraph, telephone and electric companies of the United States bought nearly three and one-half million of round poles, twenty feet or more in length. While this may form but a small proportion of the thirty-seven billion board feet of lumber produced that year, yet the decrease in the available supply of cedar and chestnut makes imperative immediate action to either conserve, preserve or substitute. Cedar is the best wood for poles, but the supply is being rapidly exhausted. Chestnut comes next in value, while small amounts of pine, cypress and redwood complete the list. The obvious remedy for their rapid destruction is the elimination of waste and the systematic replacing of timber removed. This is already being done with marked success, but so long has it been delayed that there will certainly come an interval when wooden poles will be at a premium, as the new crop cannot be grown soon enough to prevent a period of shortness.

Proper preservation promises to partially prevent this destruction. If a pole can be used for a longer time without replacement, fewer poles will be required. Its useful life can be extended by impregnating the wood with a chemical that will poison the fungi that causes decay. Just as a well-preserved old man is of more service in the successful conduct of a business than several green young men, so may a well-preserved old pole prove more efficient than a succession of unseasoned new timbers. The "elixirs of life" for timber include creosote, copper sulphate, zinc chloride and mercuric chloride, the first being the most effective. It is one of the bi-products of the production of coal gas, being distilled from the coal tar at a temperature between 400 to 700 degrees. As stated in a publication of the Forest Service, creosote made from tar produced in the oil-water-gas process and also from wood tar is not as good a preservative as the coal creosote.

The methods of applying creosote are being so rapidly improved that their details require the dignity of a special article treating of this live subject. The poles are usually seasoned with superheated steam, then soaked in creosote oil and placed under steam

pressure of at least forty-five pounds for at least four hours, being finally subjected to a vacuum until the sap ceases to flow.

Of the various substitutes, iron poles have probably been the longest in use. They are often compulsorily used in cities by electric railway companies, being made either of latticed iron or of wrought iron pipe, the latter usually being made in three or four sections and welded together. Electric light companies are using steel poles for arc lights, and long-distance, high-tension, transmission lines are being built with structural steel towers, the greater initial cost being compensated by their permanence and the greater span length permissible, which, together with the decreased auxiliary parts, such as cross arms and insulators, often make their use at least as economical.

But the latest claimant to our serious attention is the reinforced concrete pole, which has now proved to be superior after several years of severe trial. Being a single pole, they do not require the wide right-of-way necessary for towers, and they also eliminate the ever-present danger of short circuiting, that difficulty which is present wherever unprotected metal poles are used. Light poles for trolleys can be made at one place and distributed where needed, the larger ones being made horizontally on the ground, with their butts over the holes in which they are to be erected. These have proved elastic enough to withstand ordinary shocks and are almost entirely free from lightning troubles, as the reinforcing rods act as conductors. They are weatherproof, and, it is claimed, are longer lived and cheaper than steel.

While the success of these substitutes for wood, not only in pole construction but also in many other lines of structural requirements may exemplify human ingenuity in responding to necessity's demand, we should not lose sight of the fundamental necessity of correcting abuses of our natural resources that have caused such demand.

TRADE CATALOGUES.

Walter B. Snow, 170 Summer Street, Boston, Mass., has issued an attractive booklet on Productive Publicity, showing the advantages of a publicity engineer for engineering firms.

The Crocker-Wheeler Company, of Ampere, N. J., have issued several interesting bulletins. No. 95 is devoted to belt-type alternating-current generators, which are compactly built with light base to facilitate easy handling. No. 97 describes direct-current switchboard panels, Type 1, 125 to 250 volts, designed on the unit plan. No. 98 illustrates and describes Form L motors for outputs from 1/20 to 5 horsepower on 115, 250, or 500 volt direct-current circuits. Examples of the many uses to which this motor has been put are also shown. No. 99 is an interesting account of the various applications of Crocker-Wheeler motors in the Bethlehem Rail and Structural Mills. No. 100 shows Form I machines, belt type, direct current, motors 5 to 45 horsepower and generators 4½ to 40 kilowatts.

PERSONAL.

M. A. Farnsworth has established an office at 161 Second Street, San Francisco, retaining his shop and warehouse at 16 and 18 Natoma Street.

Mr. Edwin Fobes, of the Fobes Lamp Co., of Seattle, was in San Francisco one day last week on his way to the north from the jobbers' outing at Catalina Islands.

L. M. Hancock, mechanical engineer for the Fortuna Lighting Company of Fortuna, California, has returned home after a short visit to San Francisco.

G. I. Kinney is preparing to go East via Seattle to visit the companies he represents in San Francisco. These include the Northern Electric, the Fort Wayne Electric, and the Sprague Electric.

P. J. Aaron, manager of the Seattle branch of the Western Electric Company, is in San Francisco for a few days after a trip of six weeks through the manufacturing districts of the East. He reports that during his absence business at Seattle return to Seattle or remain in San Francisco and let the good return to Seattle or remainin San Francisco and let the good work go on.

REMOVAL NOTICE.

Crocker-Wheeler Company have moved into their new quarters at 32 Cortlandt Street, in the Cortlandt Building, Hudson Terminal, New York City. This 22-story building is the machinery headquarters of New York.

The executive offices of the Westinghouse Electric & Manufacturing Company, now at 111 Broadway, New York, N. Y., and the New York Sales Offices and Export Offices, of that Company now at 11 Pine Street, were removed on Monday, April 20, 1908, to the new City Investing Building, No. 165 Broadway, New York.

NOTICE OF ERRATA.

In the discussion on "Single Phase Railway," p. 236, issue of April 18, 1908, insert title "Joint Discussion by K. G. Dunn and Sidney Sprout" before last paragraph, second column.

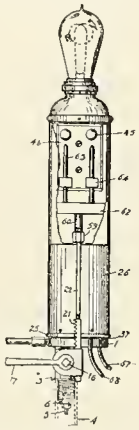
LECTURES ON RAILROAD ELECTRIFICATION AT THE UNIVERSITY OF MICHIGAN.

Mr. C. L. de Muralt, consulting engineer, and professor of electrical engineering at the University of Michigan, is giving a course of lectures to the senior electrical engineering students at Ann Arbor on the "Electrification of Steam Railroads." Prof. Muralt, who has been lecturing during the last semester on the underlying phases of this subject, such as the power station equipment, transmission and working conductors, motor characteristics, etc., intends to supplement these by a discussion of the technical and commercial features of the following subjects: (1) "The General Electrification Problem;" (2) "The Reasons for Electrification;" (3) "The Operating Characteristics of Steam and Electric Locomotives;" (4) "The Choice of Electric Systems;" (5) "An Analysis of the Cost of Operation; (6) "The Field of Railroad Electrification: The Congested Terminal, The Mountain Grade, and the Trunk Line," and (7) "Preparation of an Electrification Project for a Particular Road," special attention being directed to such problems as the design of locomotives, the calculation of run sheets, the choice of speeds, study of the peak load, the location of substations, the economics of transmission and other collateral tcpics.

PATENTS

ELECTRIC WATER HEATER. 884,343. Herbert N. Roche, San Francisco, Cal., assignor of one-half to Thomas B. Gray, San Francisco, Cal.

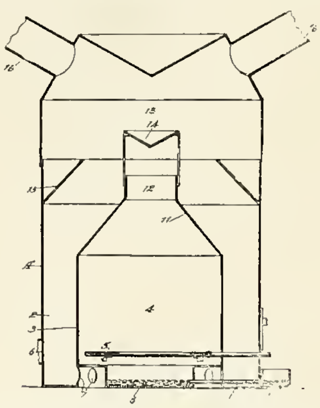
In an apparatus of the character described, the combination of a casing, a water conduit therein, an electric heating coil in conduit, a valve for controlling the passage of water



through conduit, and means for connecting heating coil with an electric circuit, comprising a stationary contact, a slidable rod contacting with a second contact and adapted to be moved into contact with the first contact and to be pressed thereon to provide a frictional resistance against the removal of slidable rod from contact, a stem for so moving slidable road, and a resilient connection between stem and rod.

GAS FURNACE. 883,880. Calvin P. Hensley and Frank H. Bryant, San Francisco, Cal., assignors to National Furnace Company, San Francisco, Cal.

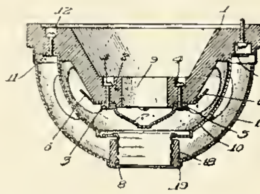
In a gas furnace, the combination of an outside cylindrical shell, an inside shell concentric therewith and separated therefrom to inclose an air passageway, inner shell inclosing a combustion chamber having draft inlets at the bottom opening



into passageway, and combustion chamber having a contracted outlet opening into the top of the furnace, a deflector arranged above inlet for radially distributing the heated particles rising from the combustion chamber, and a deflector in the form of a frustrum of a cone secured to the outer casing, and having its top terminating above the outlet from the combustion chamber and arranged to direct the hot air rising in passageway inwardly in counter-current to the heat passing through outlet from the combustion chamber, and a burner in the combustion chamber.

CLUSTER-LAMP SOCKET. 883,777. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill.

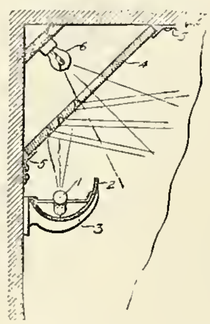
A plural lamp-holding device, comprising, in combination, a base, a lamp-receiving socket disposed to support a



lamp in a line passing through the axis of base, a center contact carried by base for socket, a series of sockets extending radially from base and each disposed to sustain a lamp in an oblique position relatively to base, a center contact carried by base for each of last-named sockets, and an outer casing provided with an opening opposite each of sockets.

ELECTRIC LIGHTING. 883,944. Walter C. Fish, Lynn, Mass., assignor to General Electric Company.

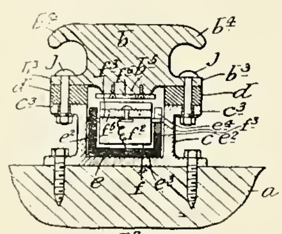
The combination, with a vapor electric lamp, of a light-transmitting reflector located in proximity thereto, and at



such an angle that light from vapor electric lamp will be reflected by reflector, and means for projecting light of a different color value through reflector to combine with the reflected light from vapor electric lamp.

THIRD-RAIL ELECTRIC RAILWAY SYSTEM. 884,170. Charles Kozesnik, New York, N. Y.

A third rail for electric railways consisting of separate hollow sections composed of top and bottom portions connected, but insulated one from another, the ends of the top



portions of sections being also insulated, the bottom of the top portions of the sections being longitudinally thickened or extended downwardly, and provided at intervals with contact devices, vertically movable armatures supported beneath contact devices and composed of separate end members, and a central contact member secured thereto, and an electrical connection for armatures.

INDUSTRIAL

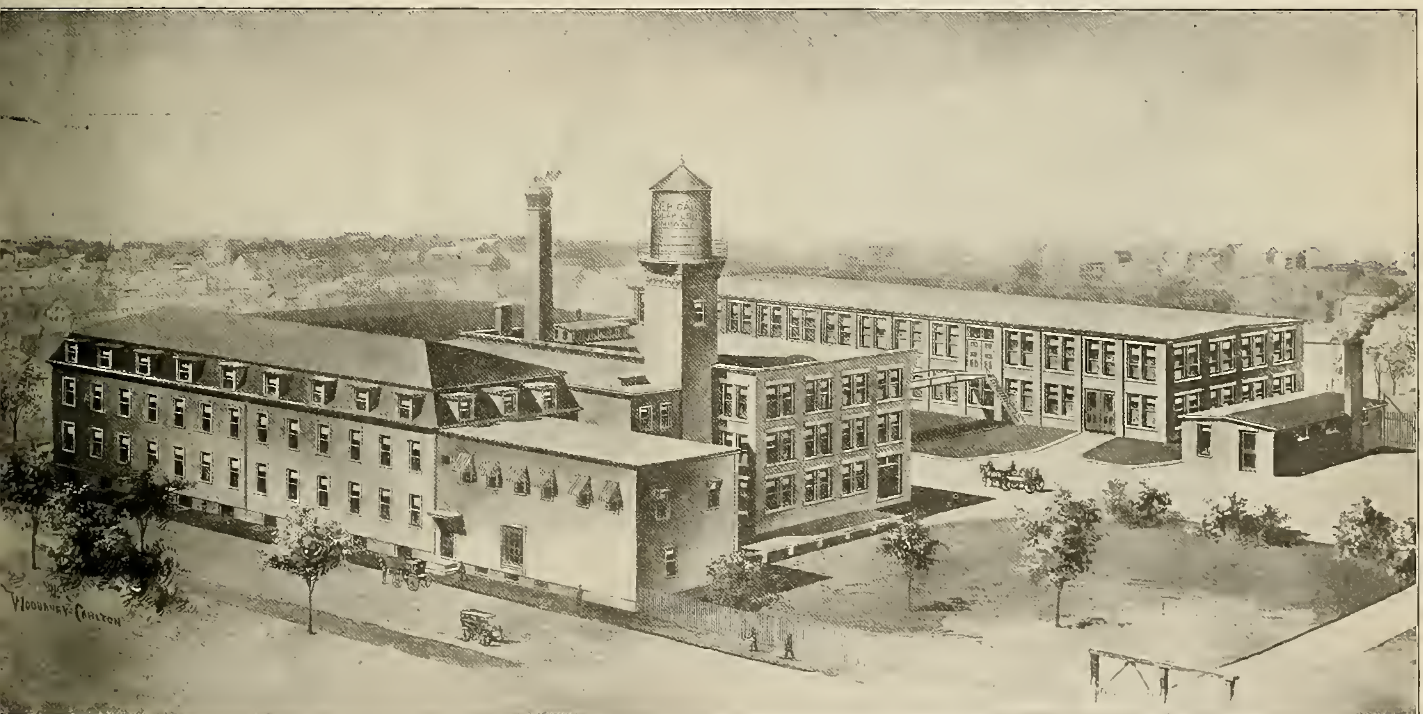
THE CHELSEA CONFLAGRATION.

As a rule, disastrous conflagrations show no mercy to the electrical business. They give no consideration to the inconvenience to the general public which follows the destruction of electric light, street railway, telephone, and other property devoted to the electrical industry. The conflagration at Chelsea, Mass., a suburb of Boston, on Sunday morning, April 12th, was no exception to this rule. In a total loss of approximately $6,000,000, the various electrical interests suffered severely.

The wire service was a complete wreck; fortunately the loss to the Chelsea Gas Light Company is confined largely to earnings, as most of the electric current in Chelsea is supplied by the Edison Electric Illuminating Company, of Boston. The loss to the Boston Elevated Railway and to the Boston and Northern Road was particularly heavy, while the Chelsea Exchange of the New England Telephone & Telegraph Company was destroyed, at a loss estimated at $20,000.

The plant of the American Circular Loom Company, manufacturers of circular loom flexible conduit, was totally destroyed; but we are advised by telegram that a complete duplicate set of machinery, which has always been held in reserve by them, will be installed in a new building and manufacturing resumed at the earliest possible moment. They estimate the delay at not to exceed two weeks. Their Pacific Coast agents, the John R. Cole Company, state that at their San Francisco and Seattle warehouses they have ample stock to keep the trade supplied for a much longer period, and additional stock in transit, and that the destruction of their factory will have no effect on Pacific Coast conditions.

Electroduct, the rigid conduit manufactured by the American Circular Loom Company, is made only at their Kenilworth, N. J., factory, and this branch of the business is therefore unaffected. Mr. A. T. Clark, president and general manager, and Mr. Alex Henderson, sales manager, of the American Circular Loom Company, have hosts of friends on the Pacific Coast, all of whom join in expressing regret at the disaster and congratulations on their ability to so quickly resume operations.



WORKS OF AMERICAN CIRCULAR LOOM CO., DESTROYED, CHELSEA FIRE.

CEMENT TESTING SAND.

On account of the large increase in the cement business throughout the United States and the correspondingly large demand for Standard Cement Testing Sand, it has been found impossible to secure adequate and regular supplies of "Ottawa" sand from the East, this having hitherto been accepted as the standard. Supplies having virtually been cut off and there being an immediate prospect of much confusion in cement testing, the Standard Portland Cement Company (Davenport) has undertaken to supply a standardized local sand in the same manner as the Sandusky Portland Cement Company who standardize and supply the "Ottawa" sand.

It is only by the general acquiescence and support of the engineers and architects of the Coast that the local sand can become the recognized standard and the threatened confusion in cement testing avoided.

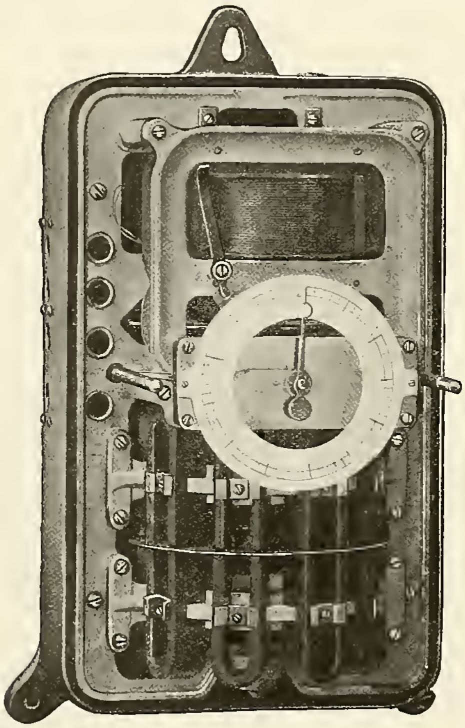
Many laboratories, mills, etc., are already entirely out of "Ottawa" sand and it is a matter of some urgency that a general expression of opinion be sent Smith, Emery & Company of San Francisco, inspecting, testing and chemical engineers.

A NEW MAXIMUM WATT DEMAND INDICATOR.

In many cases it is necessary to know the actual maximum watt consumption on alternating-current circuits, especially in motor installations.

To meet the demand for this type of instrument, the General Electric Company has just placed on the market an indicator designed to operate correctly within commercial limits on two or three phase circuits, with balanced or unbalanced, inductive or non-inductive loads. By proper connections, it may also be used on single-phase circuits.

This device is a modification of the "D-3" polyphase wattmeter, with both electrical elements acting on the top disc



5 AMP., 110 VOLT MAXIMUM DEMAND INDICATOR.

and a strong damping system acting upon the lower disc to provide the necessary time lag. In place of the usual register, there is provided a single graduated dial and two pointers. One of these is driven by the moving element through a train of gears, and indicates at any instant the energy passing through the device. The other pointer is driven by the first and remains at the maximum position reached by it, being held in this position by a ratchet. The final position reached by this second pointer indicates the maximum energy taken from the circuit. A thumb-nut is used to set the maximum demand pointer back to zero, and may be sealed to prevent tampering by unauthorized persons.

The length of time required for the pointer to reach its maximum position, or the "time lag," will depend on the torque of the motor elements and the strength of the damping magnets, and may be varied from one minute to thirty minutes. The indicator is rated by defining the time lag at 90 per cent of full scale, since between 90 and 100 per cent the movement is very slow compared with the speed from zero to 90 per cent.

The polyphase demand indicators are made self-contained in capacities from 25 to 150 amperes, 220 to 650 volts. Above these capacities, current and potential transformers must be used. The indicators are furnished with an all-metal cover finished in black japan.

MANUFACTURERS AT CATALINA ISLAND.

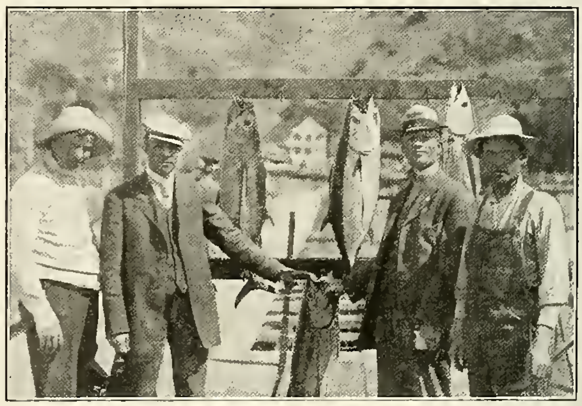
(Continued.)

A bronze medal lapel button was awarded for this distinction by the Catalina Light Tackle Club. But, hark! with the lark, as the first sunbeams burst into the next day, away to the albicore haunts sped the bronze button! And, returning as the noon approached! What! do we read the scales alright? Yes! A 36½-pound albicore, and a silver button is won by a pound and a half margin, and envy runs rampant.

For the fear of touching sunburnt spots we will not allude to the particular name of a party who took lunch a la carte wheels for six of them, spent ten more to the boatman, and lost light tackles to the tune of five dollars more with the sad final result of no fish.

Persistency, however, will always win; and the next day it was a Goodwin, for a 26-pound albicore was brought to the scales, earning for a deserving member the honor of a bronze button.

Messrs. Hillis and Holabird each were the recipient of bronze rewards for their having landed 33½ and 29¼ albicore with featherweight rods. And thus ended the second day of exciting times in the fish line, leaving behind the wrecks of many "light tackle," but a record withal which a party of equal numbers will probably never exceed.



SIMILAR.

Baseball was forgotten; golf was eschewed; meals grew cold and indifferent, but thirteen unlucky albicore were landed by the ten members, who became slaves to the art.

After witnessing the interesting spectacle of feeding the half dozen seals, which have become pets of the bay, with the surplus albicore the party mounted the Cabrillo for the mainland.

In the evening the festivities were brought to a reluctant close at Levy's Cafe, in the Angel City, by a meeting of the Sons of Jove.

Messrs. C. G. Pyle of the Standard Underground Cable Company, A. W. Ballard of the General Electric Company, Walter M. Fagan of the Telephone and Electric, T. B. Henley of the California Electric Co., and H. Conger Bowers of the F. E. Newberry Company, all of Los Angeles, were initiated into the order and rejuvenated in a fitting manner, after which a light banquet was served, felicitously presided over by Mr. Elliott, in his usually eloquent and finished fashion.

Mr. Grady, of the Faries Company, responded in an interesting manner, relating the early history of the organization, of which he was a charter member.

As the clock struck the wee-est hour of the night all was done and said, and with great sunburn and eclat good-byes of a happy throng blended with good-will and pleasing remembrances of days too quickly spent and with memories of "Auld Lang Syne" we parted to meet again, if fortune favors, sometime and somewhere, the time and place being only known to Jove and Sons. AMEN.

NEWS NOTES

TELEPHONES.

Crescent, Wash.—The Farmers' West Crescent Telephone Company is extending its line from Crescent to Curby.

Dayton, Wash.—A permit was granted A. M. Melcum to construct a telephone line along the county road.

Chehalis, Wash.—A telephone line is being built on the north fork of the Newaukum, which will be a great convenience to the farmers of that section.

San Rafael.—A petition received from D. Dolcini, asking permission to erect poles for a private telephone line between Ricky Hill and Nicasio, has been granted.

San Francisco.—The Home Telephone Company has been ordered by the Board of Works to tear up and reconstruct many of its filled trenches in the streets.

Camas, Wash.—The County Commissioners granted the Sunnyside Telephone Company a franchise along the county road from the Little Washougal bridge to Washougal.

Mesa, Wash.—The Farmers' Mutual Telephone Co. began the construction of a line from Mesa to Ringold recently, and will extend the line to Hanford later. Such a line has long been needed.

Montesano, Wash.—At the City Council meeting, C. H. Wolf, representing a Tacoma syndicate, petitioned for a telephone franchise, with the privilege of running service wires on all streets of the city.

Ephrata, Wash.—A further telephone convenience is to be constructed in the immediate future. A short long-distance line is to be built between Ephrata and Quincy, with but one intervening phone, to be located at Winchester.

Vashon, Wash.—The Vashon Island Telephone Company has been incorporated with H. Harrington president and T. Hanson secretary. The company is capitalized at $20,000, and extensive building operations have already begun.

Vacaville.—The ordinances granting to the Mutual Telephone Company, for the period of 25 years, the right to erect and maintain poles and wires for telephone purposes upon the streets and alleys of Vacaville, have been passed.

Coeur d'Alene, Ida.—Superintendent R. H. Hart, of the Rocky Mountain Bell Telephone Company, stated that the company within his district, Shoshone, Bonner and Kootenai Counties, is expending over $15,000 in improvements.

Stites, Idaho.—At a meeting held recently, P. E. Ellis, president of the Stites Telephone Company, organized a farmers' line, which will serve residents of Pleasant Valley. The Stites Company is a local co-operative association.

Gardner, Ore.—Money and rights of way are being subscribed to build a telephone line from Gardner to Scottsburg, the head of navigation, there to connect with the line from Drain. This will give this section of Oregon direct communication with the outside.

Portland.—The Portland Home Telephone Company will extend its lines into the suburbs soon. P. L. Willis is president of the company, and A. A. Andrews, general manager. The long distance facilities of the company will be increased, and connections completed with Tacoma.

San Francisco.—The Pacific Telephone & Telegraph Company is extending its two-number method of handling long distance business to include towns on the peninsula. Last week the system was made effective for handling calls between San Mateo and Burlingame and San Francisco.

Troy, Ida.—T. E. Wood, representing the Pacific States Telephone Company, has been in Troy working up a local exchange. So far, he has 27 phones pledged, and expects to install a first class system. The Pacific States will also take up and push the matter of phones into the country from Troy.

Virginia City, Mont.—The Ruby Valley Telephone Company has been organized for the purpose of building a telephone line from Alder to upper Ruby Valley points. At Alder the new telephone line will connect with the Buford line to Virginia City, and also with the Rocky Mountain Bell long distance telephone line.

Bellingham, Wash.—Announcement that about $20,000 will be expended in this city during the coming Summer in making improvements was made by Manager B. F. Reno, of the Sunset Telephone Company, following the visit of G. B. Robinson, general superintendent of company, of San Francisco, and A. H. Corcoron, division superintendent, with headquarters in Seattle. Two days were spent in going over the city, and it was decided to start the work as soon as possible.

Port Angeles, Wash.—The telephone lines covering the territory in the east end of Clallam County, and heretofore owned and operated by the Independent Telephone Company, have been taken over by the Angeles Telephone & Telegraph Company and consolidated with the lines of the local company, whose system is gradually being extended to cover the entire county. A new line is now under construction westward from this city, which will connect Lake Crescent with all the long-distance lines during the coming summer.

LIGHT AND POWER PLANTS.

Seattle, Wash.—A petition by the Seattle-Tacoma Power Company to erect and maintain poles for a 30,000-volt transmission line from the intersection of the company's present line and Beacon Avenue and Hanford Street to the intersection of the company's present line and Lander Street, has been granted.

Columbus, Mont.—Articles of incorporation of the Columbus Electric Light Company filed in the office of the County Clerk. The company is formed for the purpose of furnishing light and water to the residents of the city of Columbus and the places of business of that city. The company is capitalized at $20,000, and the directors of the company are Dr. James Craig, Henry Grant, William Cook, W. E. Anderson and H. I. Raiff.

ELECTRIC RAILWAYS.

Hanford.—Bids will be received till May 4th for the electric railway franchise applied for by F. S. Granger.

San Diego.—The ordinances granting railway franchises to E. W. Peterson in South San Diego have been passed by the County Board of Supervisors.

Riverside.—Manager W. W. Pool, of the Southern California Cement Company, states that he hopes that the trolley line from Riverside to Crestmore will be completed by May 1st.

Reno.—Promoters of the electric line to Steamboat Springs say the line will not be ready for operation until September. They are also figuring on extending it eventually to Jumbo, the new mining camp on the west side of the Virginia City range.

Santa Cruz.—General Manager F. E. Fitzpatrick, of the Coast Counties Power Company, says that the Sequel extension will be completed to the corporate limits within the present year. Another steam turbine is to augment the capacity of the plant at the beach.

American Falls, Idaho.—Assurance has been given settlers on lands under the American Falls canal, a project covering 65,000 acres between Blackfoot and American Falls, that an electric line will be built in the course of a year to connect the above-mentioned cities, and thus afford the settlers of this rich tract railroad facilities.

Los Angeles.—That work on the new electric railway between Los Angeles and Pasadena will begin within the next few months is foreshadowed by demolition of the old Pasadena elevated cycleway. Horace M. Dobbins, of Pasadena, is promoter of both the cycleway and railway projects. The estimated cost of the railway will be $2,500,000.

New Westminster, B. C.—Electric locomotives with a possible speed of sixty miles an hour will be the motive power employed by the British Columbia Electric Company on the new line from the city to Chilliwack. The line will be formally opened on May 24, 1910, and tenders are now being invited for the building of the powerful electric engines that will haul the first trains over the road.

Portland, Ore.—Requests for franchises to build street car lines on many streets in the outlying districts, so as to serve the growing suburban territory with new lines, will be made within the next few days by President Josselyn, of the Portland Railway, Light & Power Company. The council will be asked to permit the laying of tracks throughout a large district on the East Side, where the growth of population has outdistanced the car lines.

Oakland.—An extension of the Key Route system, including the establishment of a passenger and freight depot in the block bounded by Twelfth, Fourteenth, Union and Poplar Streets, and contemplated service over Twelfth Street through the heart of the city into Hayward and adjacent suburban territory, are indicated by the activity of agents of the corporation in securing subscribers to a petition for a right of way along Poplar Street, and in the purchase of all the property in the block designated. Connection with the Emeryville pier will be had by a line along Poplar Street, extending south from Twenty-second.

Oakland.—By a resolution passed by the Oakland Board of Public Works, the Oakland Traction Company is directed to widen the distance between its tracks on Broadway, between First and Fourteenth Streets. A protest was entered on behalf of the Traction Company by its representative, Engineer Boggs, who endeavored to delay action by the city on the plea that the company's finances would not permit of the work being done at this time. Mr. Boggs submitted blue prints and figures showing that to widen the distance from 9½ feet to 11 feet between the centers, as on other streets, would necessitate an expenditure of from $50,000 to $70,000, and also result in the suspension of all traffic on lower Broadway while the work is in progress. Mr. Boggs suggested the opening of Washington Street for the operation of cars, thereby lessening the burden of travel on Broadway. He said his company had been considering the plan for two years, but thought they ought to be allowed to derive some further service out of the expenses put into lower Broadway already.

FINANCIAL.

Lodi.—The election to determine whether or not the city shall issue bonds in the sum of $50,000 for a sewer system and $76,000 for a water and light system will be held May 4th instead of May 5th.

Bakersfield.—The directors of the Associated and Amalgamated Oil Companies held a meeting in the company's offices at Kern River last week. It was decided to call a dividend of $1 a share per month on the 50,000 shares of the Amalgamated. This means an annual dividend of $600,000.

San Francisco.—The first official statement of the loss in gross earnings sustained by the United Railroads Company during the strike of last year is contained in a brief annual report of President Calhoun, which has just been made public. His report of gross earnings for 1907 shows $4,745,116, as compared with $5,955,786 in 1906, a decrease of $1,210,670. This latter sum is, therefore, the loss in gross receipts alone, caused by the strike which began May 5th and continued until late in the fall. The expense the company was put to in fighting the strikers is not set forth.

ILLUMINATION.

The California State Board of Prison Directors have decided that more light is needed at Folsom, and it was decided to advertise for bids for the construction of a $6,000 additional electric plant. Bids will be received on May 11th.

San Francisco.—The final payment of $5 per share with six months' interest has been made on the Mutual Electric Light Company's certificates. The third payment of $5 per share with six months' interest was also made on the extended certificates of this company.

Riverside.—Estimates are now being received by the Beaumont Land and Water Company for the complete equipment of a pumping plant, to be installed at Beaumont. The machinery wanted is one 60-horsepower gasoline engine; one Ingersoll-Sargent air compressor, 60-horsepower; one oil storage tank, capacity 1 carload, together with pipes, fittings, etc.

INCORPORATIONS.

Los Angeles.—The Electric Equipment Company has been incorporated with a capital stock of $20,000.

Los Angeles.—Articles of incorporation have been filed by the Mono Lake Oil Company with a capitalization of $2,000,000.

Honolulu.—At the last meeting of the Board of Directors of the Hawaiian Electric Company it was decided to double the capacity of the present plant.

San Francisco.—The St. Lawrence Oil Company has been incorporated by A. Y. Hardenburgh, M. L. Friedlander, and J. D. Lederman. The capital stock is $100,000.

San Francisco.—The Camino Real Water Company has been incorporated with a capital stock of $200,000 by M. D. DeLaney, S. Foster, and R. A. Orett. The principal place of business is San Francisco.

Bakersfield.—Articles of incorporation have been filed by the Loveland Oil Company with a capitalization of $25,000. The incorporators are E. H. Loveland, T. W. Helm, G. T. Kinkade, C. A. Lee and others.

Bakersfield.—The Kern Mutual Telephone Company has filed articles of incorporation with a capital stock of $25,000. The directors are H. W. Thomas, J. T. McGuire, T. S. de Lacy, F. G. Munzer and R. Galloway.

Visalia.—Articles of incorporation have been filed by the Blacherns Water Company with a capital stock of $10,000. The directors are W. P. Bartlett, Grace Redfield, V. D. Knupp, A. E. Brooks, and Jacob Sturm, all of Porterville.

Redlands.—Articles of incorporation of the Standard Gas & Electric Company have been filed with the County Clerk. The capital stock is $50,000, and the principal place of business is Los Angeles. The directors are Walter S. Camp, Horace Slater, and R J. Dunn.

Chico.—J. W. Roper, of the Midas Gold Mining Company, operating in Shasta County, states that the company will spend between $40,000 and $50,000 in the erection of a power plant on Bee Gum Creek, to generate power for the mine, which will be seven miles distant from the power house. The company has filed on 5,000 miner's inches of water. About 800 horsepower will be generated at first, but this will in time be increased to 2,000 horsepower.

TRANSMISSION.

Ukiah.—Superintendent Irving H. Brush, of the Ukiah Water & Improvement Company, reports that the company will install a 60 horsepower electric pumping plant at its station on Russian River.

Oakland.—The Stanislaus Electric Power Company is commencing to erect towers near Midway and through the hills of Alameda County, according to a statement made a few days ago by I. B. Parsons, who has been securing a right of way for the power lines through this part of the county.

Nevada City.—Chief Engineer Downing, of the Pacific Gas & Electric Company, is at this place to inspect officially all the company's plants in the county. The plant on Deer Creek is practically ready for operations. When the water is turned on it will generate about 8,000 horsepower, and the electricity will be carried to the valley and bay towns.

TRANSMISSION.

Portland, Ore.—Contracts have been let to the Risdon Iron Works, San Francisco, for a large quantity of steel pipe for the penstocks at the power station now being built by the Mount Hood Railway & Power Company at Bull Run.

Wenatchee, Wash.—J. M. Duffy and O. B. Fuller have closed contracts with the Wenatchee Electric Company for power to run the motors on their land west of the city, with which they will pump water for irrigation. Mr. Duffy will have a 25-horsepower motor, and Mr. Fuller will have a 7½-horsepower.

Orient, Wash.—The application of Arthur Phillips and H. D. Merritt for a franchise to operate and maintain a system of water works in the streets and alleys of Orient, and giving them the right to erect and use wires for conveying electricity for light and power along the public highways in Ferry County, was heard and granted by the board of county commissioners.

Wenatchee, Wash.—T. Clark, ex-Mayor Schebe, and Marvin Chase have ordered the machinery for the power plant they will install in the Wenatchee Valley this summer. They formed the Valley Power Company a year ago, but nothing definite has been done to establish the company until recently. The company intends to develop an enormous water-power proposition on the Wenatchee River, five miles above Cashmere.

Seattle, Wash.—The Seattle-Tacoma Power Company recently obtained a permit to erect a two-story brick power station at 1319-1323 Western Avenue. It will adjoin the transformer house of the same company, and machinery will be installed to generate 1,500 horsepower. Facilities are provided for doubling the capacity when desired by the installation of a duplicate of the new palnt. Excavations have been made, piles driven, and the concrete is now being poured into the wall frames.

Helena, Mont.—Without warning, the great dam at Hauser Lake, on the Missouri River, 15 miles north of this city, partially gave way recently, causing a damage estimated at $250,000. The Hauser Lake dam, which was one of the finest structures of its kind in the world, was completed last year, at a cost of more than $2,000,000, and developed a horsepower of 25,000, which was utilized in operating the various power plants in Helena and the Butte mines and the Amalgamated Copper Company's smelter plants at Anaconda.

POWER AND LIGHT.

Berkeley.—Berkeley is to have a competing electric light company, according to an announcement made by Samuel L. Napthaly, consulting engineer for the San Francisco City Electric Light Company.

Las Vegas, N. M.—An electric light plant will be installed in the near future at the Territorial penitentiary. A combination engine and dynamo has been ordered from the Westinghouse Electric Company, and is expected to arrive some time in April.

ELECTRIC RAILROADS.

Eugene, Ore.—The Oregon Electric is going to build south at once to Eugene. This has been confirmed by Guy Talbot, general manager of the road.

Vancouver, B. C.—The British Columbia Electric Railway Company has sent out a survey party to run a line up Lynn Valley for a distance of about six miles.

Tacoma, Wash.—An ordinance giving the Puyallup Valley Northern Rapid Transit Company the right to enter the city, has been introduced. This is the old Chambelain Company, whose franchise was allowed to lapse. The new franchise covers all the rights granted in the first one.

Walla Walla, Wash.—The County Commissioners have granted a franchise to the Washington & Oregon Traction Company to construct and operate an electric railway along the edge of the cemetery. The company must start construction by the first of the year, and have the road completed by January 1, 1910.

New Westminster, B. C.—Managing Director J. Buntzen, of the British Columbia Electric Railway, has made the announcement that tenders will be called for at once for the construction of that portion of the new Chilliwack electric line between this city and Cloverdale, and work on grading and track-laying will be commenced within a month.

Spokane, Wash.—A. M. Dewey, of Spokane, is projecting an electric railway from Spokane to Omak, Okanogan County, Wash., 200 miles, to connect with the proposed Okanogan Electric Railway, thus shortening the distance between Spokane and the Puget Sound country and the Canadian Northwest, by 100 miles. Mr. Dewey is the promoter of the Okanogan Electric Railway Company, which has franchises, right of way and a charter for a steam or electric railway covering much of the mining district in Okanogan County.

San Francisco.—The special committee of the Board of Supervisors—Messrs. Jennings, Murphy, Broderick and Johnston—who were appointed to select experts to investigate the affairs of the San Francisco Gas & Electric Company preliminary to fixing the rates for the coming fiscal year, have definitely engaged A. M. Hunt to do the engineering work, and Charles D. Stuart to expert the books and accounts of the corporation. The total outlay for the work is not to exceed $2,000.

Chicago.—Permanent headquarters of the International Independent Telephone Association were opened in Chicago with the idea of inaugurating a policy of aggressiveness that the organization expects will put a new complexion upon the telephone situation in America. For the first time in the history of the Independent telephone movement and the organization of the association there is a salaried president and a salaried secretary, both of whom, with a corps of assistants, will devote their entire time to organization and field work.

Classified List of Advertisers

(Continued on second page following.)

THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 2, 1908 No. 18

LIGHTING SYSTEM OF THE ORCUTT OIL FIELDS.

By CLEM A. COPELAND.*

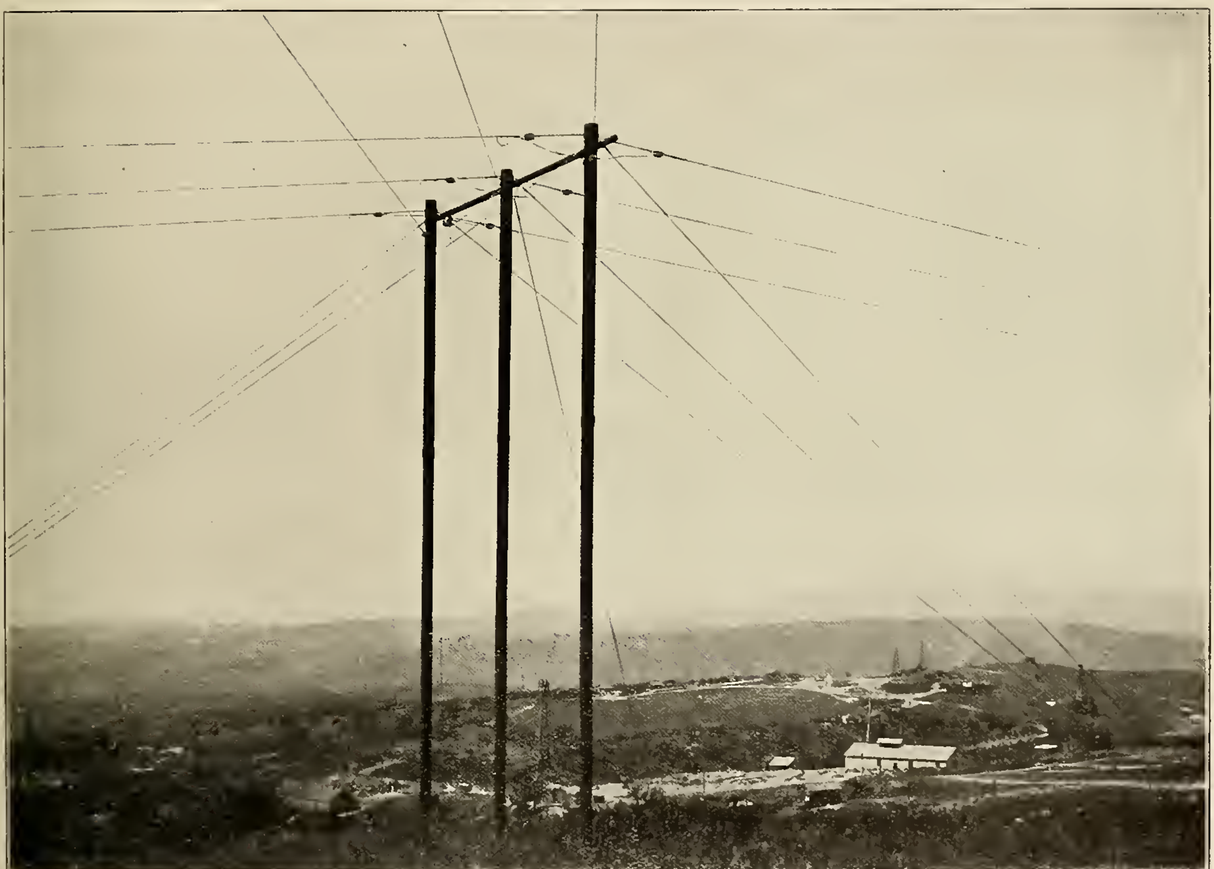
The large and deep-lying oil-sand lakes and subterranean gas works, commencing with the southern rim of the Santa Maria Valley and stretching away for a dozen miles southward toward Santa Barbara, contribute some 14,600,000 barrels of high gravity refining and fuel oil to California's annual production of 40,000,000 barrels.

With the assistance of two eight-inch pipe lines 32 miles to Port Harford, a similar line 48 miles across the Isthmus of Panama, and a goodly fleet of vessels, the Union Oil Company scatters this oil from Seattle to San Diego, and from New York to Japan. Chile also has a share for the working of its nitre beds and its railways.

The little towns of Santa Maria and Orcutt receive with open pipes a tithe of the gas which nature has here stored, and which would otherwise escape the many safety valves, while the steam rig engines have often been run with direct gas pressure from the wells.

This land of gas and gushers is difficult of control, and is always ready to pop off at from 100 to 400 pounds pressure through the many 3,000-foot tubes which puncture its depths.

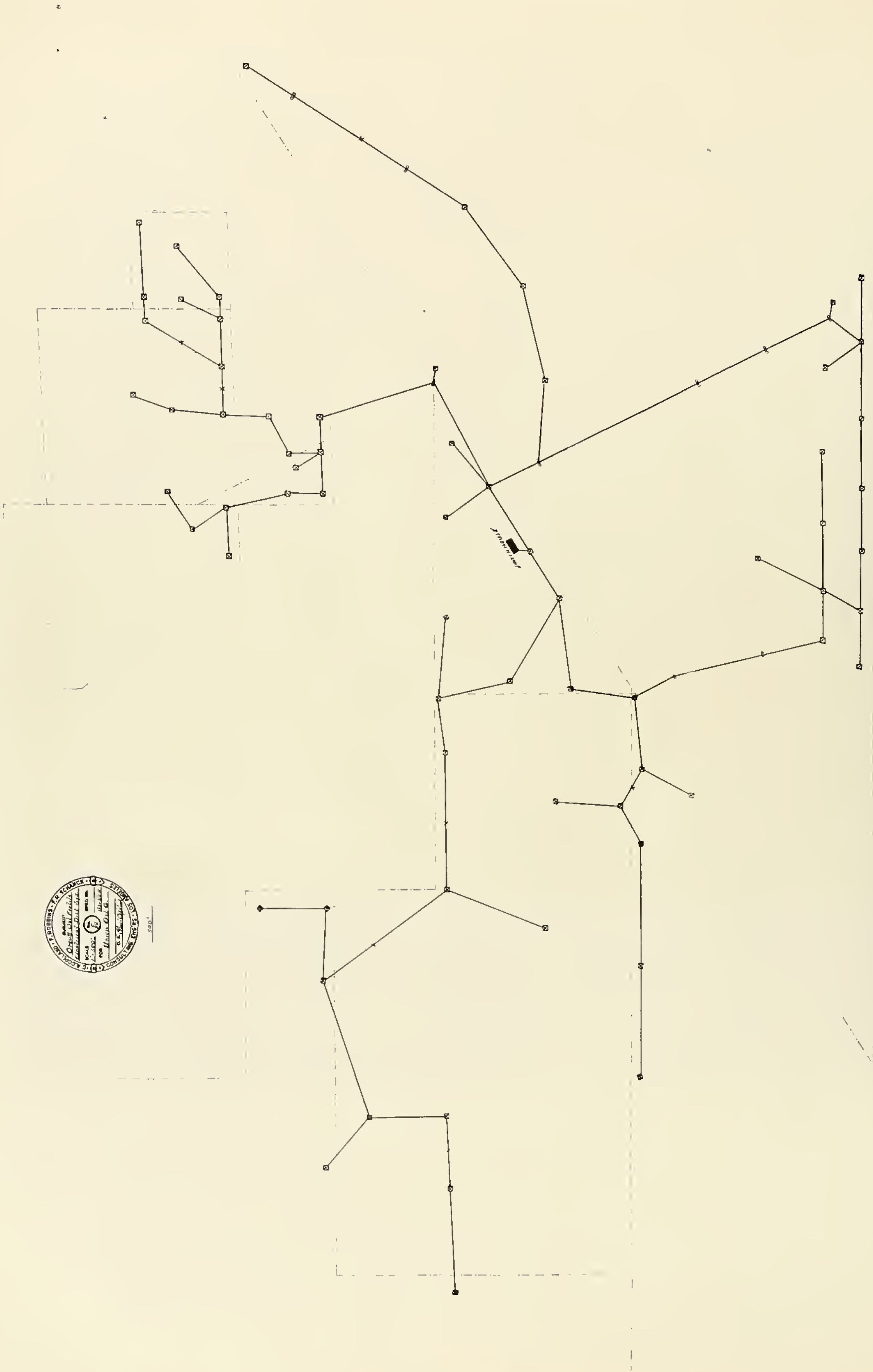
When a new gusher is brought in, it sprays the adjacent hills with a glistening shadow of petroleum and is no respecter of persons or property. One new and frisky fury flowed 12,000 barrels per day, and delivered 4,000,000 cubic feet of gas every 24 hours for four months, gradually dropping to a production of 7,000 barrels, which it maintained for nearly a year, finally diminishing to 3,500, and now, after three and a third years, is still producing 250 barrels per day, having delivered during this time 3,000,000 barrels of petroleum, and enough gas to last San Francisco for three years. This is, with perhaps one exception, the most remarkable well in the history of oil industry, and is widely known as "Hartwell No. 1."



WEST FRAME OF 2600 FT. SPAN. POWERHOUSE IN BACKGROUND.

The district contains two groups of wells, one contiguous to Orcutt, and the other near Lompoc. Danger from fire due to the excessive gas pressure of the Orcutt fields is exceedingly great, as evidenced by the burning of four "rigs" in the first two years of its history, during which time there were fifteen wells brought into production. The cost of these "rigs" exceeded the cost of the lighting plant, which is described in these notes, and no fires have since occurred in

*Consulting Engineer, Los Angeles, Cal.



MAP OF ORCUTT OIL FIELDS ELECTRICAL DISTRIBUTION SYSTEM.

the sixty wells now producing. The advisability of the plant is therefore quite patent.

The lighting system employed in the Orcutt oil fields is perhaps only interesting in illustrating how the methods employed in large undertakings may be used to great advantage in the smaller enterprises to effect a large saving and to simplify conventional methods. The smaller undertakings often afford opportunities of saving a larger percentage in cost and operation in connection with the larger ones. In the present instance, an economy of $9,000 was made in a system which would have cost $30,000 if constructed along conventional lines.

As may be seen from some of the views in these notes, the country covered by the system is very hilly and stony, hard sandstone being everywhere prominent. Trees would have interfered considerably over perhaps a third of the line with ordinary construction, and being oak, it would have cost heavily to eliminate them. Although the winters in this section are very bleak and windy, no snow has ever fallen. The attached map shows the wells, which are unusually far apart and scattered over some 5,000 acres of land.

Long span work, employing copper cables, and using the oil-well derricks for support, seemed well to meet these and all other conditions in the most economical fashion. The adoption of long span work effected a large saving in the length of line and wire needed to cover the territory, since air-line routes could be covered in all cases across country, without any care being taken to lay out a pole line which would conform to some general inflexible plan. Moreover, much vertical distance was saved in not having to follow the contour of the country. Incidentally the long span work makes the installation of new pieces of line very easy and simple, and no large amount of material need be kept on hand for expansion purposes.

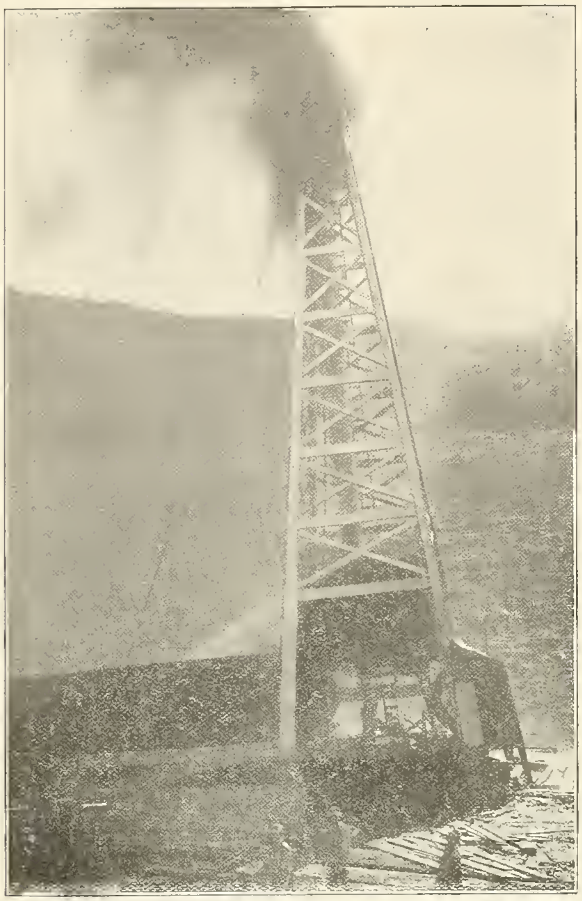
Where conditions are rapidly changing, as in the present instance, existing lines having to be moved because of the abandonment of wells or re-arrangement as new wells come in amongst the old ones, are easily changed, with but little loss of labor and material. The derricks, 80 feet in height, make ideal supports for long-span construction, and steel frames, heavy enough for the largest size of wire, eventually were made of "scrap" pipe set in cement. Where the derricks were not available, redwood "dead-men" were also used between derricks which were near together, but on opposite sides of rises or hills. The present system of distribution is 72,550 feet, or 13.75 miles, in length, and consists of 70 derricks, 9 frames, and 10 "dead-men," making the average span about 800 feet. The seven-strand bare copper cables used in this work were furnished under rigid specifications previously described in the "Journal," by the Standard Underground Cable Company. One will observe from the map and photos that there are many spans 1,500 feet in length, one span of 2,000 feet between derricks and one 2,600 feet from one frame to another. The sags allowed correspond to 60 feet on a 2,000-foot span, and the cables were very small for such work, No. 6 being used for the greatest lengths, which occurs as a neutral on the longest spans. The sizes used are Nos. 2, 4, and 6.

FRAME BETWEEN 1500 AND 1600 FT. SPAN.

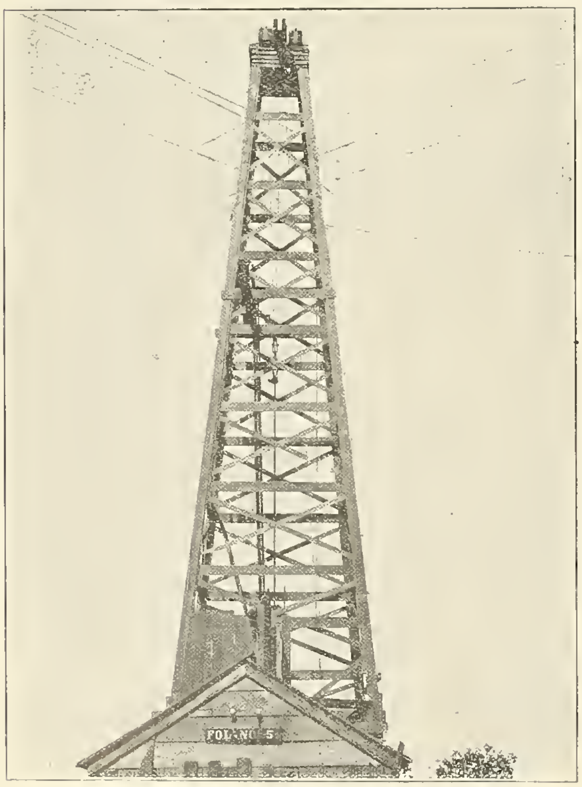
As the cables were suspended high above the ground and good construction was relied upon for safety from breakage, they were used without insulation, and a large saving was thus effected. "Goose-egg" strain insulators, first designed by the writer several years ago, are used to insulate the cables. Copper sleeves were used to splice the cables and to loop them to the insulators.

It is of considerable interest to observe the action of these light cables in a high wind, for even in the most gusty storms there is no whipping action. In the longer spans, the cables hang absolutely parallel and sway in a most deliberate manner from 12 to 25 feet out of line.

Inasmuch as fuel economy is of little importance, since either waste gas or oil can be used, a large drop in the distributing system is permissible, and a radius of three or four miles from the power-house can be economically attained by the use of 210 to 250 volt lamps on the three-wire direct-current system. At present the maximum distance is 255



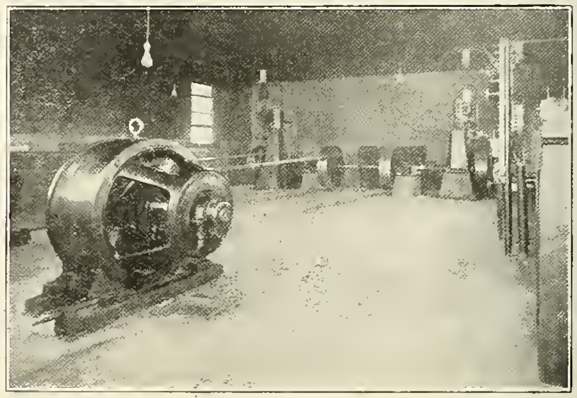
HARTWELL NO. ONE.



DETAIL OF DERRICK CONSTRUCTION.

miles, and four voltages of lamps are employed. The derricks are wired on the two-wire system with No. 14 T. B. W. P. medium, hard-drawn wire, care being taken to keep all wires on the outside of derrick house wherever possible. Although the wires and insulators have been in some cases completely sprayed and saturated with oil from the gushers, no troubles of insulation have been experienced.

At the time this work was started, there was a small plant on the Pinal Oil Company's property near by, where keyed sockets were used until one of the drillers was injured by a gas explosion caused by turning off one of the lights. This, of course, suggested the care necessary to guard against such accidents. In the present installation, double-pole fuses were constructed for each derrick and tank house, by using two weatherproof sockets and Edison plug fuses, all inclosed in a gauze cylinder like a Davy mine lamp. Switches for tank house and derricks were also inclosed in gauze. In wiring the derricks, sleeves were used for splicing, so that in the whole system no solder nor torch was used.



POWER-HOUSE.

Specially designed heavy wire lamp guards and portables, with wires inclosed in cotton-covered garden hose, are other features of the derrick wiring. When drilling is commenced, the derrick is wired for eleven lights. Tank houses, some fifteen or twenty in number, are wired with a light over each tank.

The power-house is of only passing interest, being designed for reliability and minimum first cost, and with the idea of transplanting it to some new location should future conditions dictate. The view shows two 10x10 Shepherd engines, clutched to either end of a shaft, from which two 45-kilowatt, 250-volt, direct-current Westinghouse generators are belted. In case of accident to one generator, a switch on the switchboard converts the 3-wire to a 2-wire system, using the two outside wires as one, and the neutral as the return conductor. Three 48x14 fire-tube boilers supply steam at 125 pounds pressure. The power-house is in a perennially cool location on a hill crest, so that it could be made small and cozy.

The system has been in uninterrupted and satisfactory operation for two years. The only trouble during the time was caused by one wire of one span breaking, due to an imperfection in splicing. The section has long-continued and severe winds, much rain and cold weather, but two winters have developed no imperfections. Although the lights burn all night, no interruption has been experienced. Reliability is important, since, if the lights failed, there would be a temptation to light candles or lanterns at a critical time.

The system was designed and supervised by Mr. Copeland, of Messrs. Clem. Copeland and F. R. Schanck, consulting engineers for the Union Oil Company. Mr. C. W. Crawley, who is at present electrical superintendent, was foreman of construction.

ALCOHOL vs. GASOLINE FOR POWER.

The Technologic Branch of the United States Geological Survey, under the direction of Mr. J. A. Holmes, has recently completed an elaborate series of tests on the relative value of gasoline and alcohol as producers of power. The tests, over two thousand in number, probably represent the most complete and exact investigation of the kind that has been made, either in this country or abroad, and includes much original research work.

Correspondingly well-designed alcohol and gasoline engines when running under the most advantageous conditions for each, will consume equal volumes of the fuel for which they are designed. This statement is based on the results of many tests made under the most favorable practical conditions that could be obtained for the size and type of engines and fuel used. An average of the minimum fuel consumption values thus obtained, gives a like figure of eight-tenths (.8) of a pint per hour per brake horsepower for gasoline and alcohol.

Considering that the heat value of a gallon of the denatured alcohol is only a little over six-tenths (.6) that of a gallon of the gasoline, this result of equal fuel consumption by volume for gasoline and alcohol engines probably represents the best comparative value that can be obtained for alcohol at the present time, as is also indicated by continental practice. Though the possibility of obtaining this condition in practice here has been thoroughly demonstrated at the Government Fuel-testing Plant, it yet remains with the engine manufacturers to make the "equal fuel consumption by volume" a commercial basis of comparison.

The gasoline engines that were used in these tests are representative of the standard American stationary-engine types, rating at 10 to 15 horsepower, at speeds of from 250 to 300 revolutions per minute, while the alcohol engines were of similar construction and identical in size with the gasoline engines.

The air was not preheated for the above tests on alcohol and gasoline, and the engines were equipped with the ordinary types of constant level suction lift and constant level pressure spray carburetters. Many special tests with air preheated to various temperatures up to 250° Fahrenheit, and tests with special carburetters were made, but no beneficial effects traceable to better carburation were found when the engines were handled under the special test conditions, including constant speed and best load.

The commercial completely denatured alcohol referred to is 100 parts ethyl alcohol plus 10 parts methyl alcohol plus one-half of one part benzol, and corresponds very closely to 94 per cent by volume or 91 per cent by weight ethyl alcohol (grain alcohol).

No detrimental effects on the cylinder walls and valves of the engines were found from the use of the above denatured alcohol.

The lowest consumption values were obtained with the highest compression that it was found practical to use; which compression for the denatured alcohol ranged from 150 to 180 pounds per square inch above atmosphere.

Eighty per cent alcohol (alcohol and water) for use in engines of the present types would have to sell for at least 15 per cent less per gallon than the denatured alcohol, in order to compete with it. The minimum consumption values in gallons per hour per brake horsepower for 80 per cent alcohol is approximately 17.5 per cent greater than for the denatured alcohol used, or for gasoline. A series of tests made with alcohol of various percentages by volume ranging from 94 per cent to 50 per cent, showed that the minimum consumption values in gallons per hour per brake horsepower increased a little more rapidly than the alcohol decreased in percentage of pure alcohol. That is, the thermal efficiency decreased with the decrease in percentage of pure alcohol. This decrease in thermal efficiency or increase in consumption referred to pure alcohol is, however, comparatively slight from 100 per cent alcohol down to about 80 per cent alcohol. Within these limits it may be neglected in making the calculations necessary to compare the minimum consumption values for tests with different percentages of alcohol.

The nearer the alcohol is to pure, the greater the maximum horsepower of the engine. The per cent reduction in maximum horsepower for 80 per cent alcohol as compared with that for denatured alcohol used, was less than one per cent, but the starting and regulating difficulties are appreciably increased.

With suitable compression, mixtures of gasoline and alcohol vapors (double carburetters) gave thermal efficiencies ranging between that for gasoline (maximum 22.2 per cent) and that for alcohol (maximum 34.6 per cent) but in no case were they higher than that for alcohol. The above thermal efficiencies are calculated from the brake horsepower and the low calorific value of the fuel, which for the gasoline was 19,100 British thermal units per pound, and for the denatured alcohol was 10,500 British thermal units per pound.

As has been previously published, alcohol can be used with more or less satisfaction in stationary and marine gasoline engines and these gasoline engines will use from one and one-half to twice as much alcohol as gasoline when operating under the same conditions. The possibilities, however, of altering the ordinary gasoline engines as required to obtain the best economies with alcohol are very limited; for the amount that the compression can be raised without entirely redesigning the cylinder head and valve arrangement is ordinarily not sufficient, nor are the gasoline engines usually built heavy enough to stand the maximum explosive pressures, which often reach six and seven hundred pounds per square inch. With the increase in weight for the same-sized engine designed to use alcohol instead of gasoline, comes an increase in maximum horsepower of a little over thirty-five per cent (35%), so that its weight per horsepower need not be greater than that of the gasoline engine, and probably will be less.

The work was taken up to investigate the characteristic action of fuels used in internal combustion engines with a detailed study of the action of each fuel (gasoline and alcohol) as governed by the many variable conditions of engine manipulation, design and equipment. These variables were isolated, so far as possible; their separate and combined effects were determined; worked out under practical operating conditions; and led up to the conditions required for minimum fuel consumption. The results show the saving that can be obtained over conditions for maximum consumption, and also establish a definite basis of comparison under conditions most favorable to each fuel. This latter is a point of much commercial interest, and a study of the comparative action of gasoline and alcohol may be of great service in solving some of the general internal-combustion-engine problems where other than liquid fuels are used.

A large number of fundamental tests were necessary in order to clearly define conditions and interpret results. In a way they follow the work conducted by the Department of Agriculture, supplementing to a certain extent, but not duplicating bulletin 191, which gives much data of general value.

Many of the tests of internal-combustion engines have been made, but most of them, especially in this country, were by private concerns, for a specified purpose, and the results are not generally available. Furthermore, as is generally recognized by those familiar with gas, and especially gasoline-engine operation, the conditions influencing engine performance are so numerous and varied as to make the value of offhand comparison very limited and oftentimes misleading, exact comparisons only being possible under identical conditions or with reference to the actual known differences in all conditions that influence the results.

ELECTRICAL CODE REVISIONS.

At the recent meeting of the Underwriters' National Electric Association it was decided that Cooper Hewitt lamps must have a cut-out for each lamp or series, except when contained in a single frame and lighted by a single operation, in which case not more than five lamps shall be dependent on a single cut-out. The regulators must be enclosed in non-combustible cases, and where subject to flyings of lint or combustible material, all openings through the casings must be protected by a fine wire gauze. Moore electric light tubes must be installed so as to be free from liability to mechanical injury or of contact with inflammable material. The high-potential coils and regulating apparatus must be installed in an approved steel cabinet, which shall be ventilated in such a manner as to prevent the escape of flame or sparks in case of burn-out. The apparatus in this box must be mounted on slate, and the enclosing case positively grounded. The supply conductors must comply with the rules governing low-potential systems where such wires do not carry current having a potential of over 300 volts.

Rule 8, section *d*, was amended to apply to auto-starters only, and a new section was added to rule 60 governing the details of rheostat construction. New rules regarding low-potential transformers follow: Oil transformers must not be placed inside of any building except central stations and sub-stations, unless by special permission of the inspection department. Air-cooled transformers must not be placed inside of any building excepting central stations and sub-stations, unless the highest voltage of either primary or secondary does not exceed 550 volts, and must be so mounted that the case shall be one foot from combustible material or separated therefrom by non-combustible, non-absorptive, insulating material, such as slate or marble. Where transformers are placed at a lesser distance, a slab of slate or marble somewhat larger than the transformer must be used, and where the transformer is mounted on a side wall, the slate or marble must be secured independent of the transformer supports, the transformer being supported by bolts countersunk at least one-eighth inch below the surface of the back of the slab and filled.

For wiring electric cranes the following rules were adopted: All wires except bare collector wires, those between resistances and contact plates of rheostats and those subjected to severe external heat, must be approved, rubber-covered and not smaller in size than No. 12 B. & S. Wires between resistances and contact plates of rheostats must conform to No. 4-c, unless the wires are exposed to moisture, in which case the insulation must also be rubber. Wires subjected to severe external heat must have approved slow-burning insulation. All wires, excepting collector wires and those run in metal conduit or armored cable, must be supported by knobs or cleats which separate them at least one inch from the surface wired over, but in dry places where space is limited and the distance between wires as required by Rule 24-h cannot be obtained, each wire must be separately encased in approved flexible tubing securely fastened in place. Collector wires must be supported by approved insulators so mounted that even with the extreme movement permitted the wires will be separated at all times at least one and one-half inches from the surface wired over. Collector wires must be held at the ends by approved strain insulators.

Where the wires are arranged in a horizontal plane above the crane, they must be supported at least every twenty feet if practicable, and separated at least six inches, but if longer spans are necessary, the distance between wires must be increased proportionately, the span in no case to exceed forty feet. If not arranged in a horizontal plane, they must be carried along the runways and must be rigidly and securely attached to their insulating supports at least every twenty feet, and if not arranged in a vertical plane, must be separated at least eight inches.

Where bridge collector wires are over eighty feet long, insulating supports on which the wires may loosely lie must be provided at least every fifty feet. Bridge collector wires must be kept at least two and one-half inches apart, but a greater spacing should be used whenever it may be obtained. Collector wires must not be smaller in size than specified in the following table for the various spans:

Distance between rigid supports. Feet.	Size wire required. B. & S.
0 to 30	6
31 to 60	4
Over 60	2

Collectors must be so designed that sparking will be reduced to a minimum between them and collector wires. The main collector wires must be protected by a cut-out and the circuit controlled by a switch, cut-out and switch to be so located as to be easy of access from the floor. Cranes operated from cabs must have a cut-out and switch connected into the leads from the main collector wires and so located in the cab as to be readily accessible to the operator. Where there is more than one motor on a single crane, each motor lead must be protected by a cut-out located in the cab if there is one.

Controllers must be installed according to No. 4, except that if the crane is located outdoors the wires between resistances and contact plates of rheostats may be rubber-covered or bare or slow-burning if properly supported. If the crane operates over readily combustible material, the resistances must be placed in a fire-resisting enclosure; or, if located in a cab, the cab must be constructed of non-combustible material and sides provided which enclose the cab from its floor to a height at least six inches above the top of the resistance.

The motor frames, the entire frame of the crane and the tracks must be permanently and effectively grounded.

A number of recommendations were made calling for conductive coatings on cables, outlet boxes and fittings in order to secure better electrical contact at all points throughout systems in which they are used.

The following suggested changes in the rules were adopted: The fine print note under rule 2, section a, was amended to read as follows: "Wires from generator to switchboard may, however, be placed in conduit, provided that proper precautions are taken to protect them against moisture and mechanical injury. If lead-covered cable is used no further protection against moisture will be required, etc." Section c of the same rule was amended by inserting the words, "where not in conduit," after the first word. The last sentence of the fine print note in rule 12, section g, was amended to read: "The outer or weather end of conduit is to be provided with approved devices having wires separated and bushed through porcelain."

A number of changes were made in rule 24. Section a, with fine-print note, was stricken from the Code; section o was amended by making the first recommendation "a turn of 90 deg., etc."; section p was amended so as to restrict the number of different circuits in the same conduit to four two-wire or three three-wire; section x was changed by substituting the word *or* after the word *fastenings* for *of*. Rule 24A was also changed somewhat. Section d was amended so as not to prohibit the installation of armored cable without the lead covering in buildings of fireproof construction in locations free from moisture; the word "underground" was omitted from the first line of the fine-print note under section a. A new section was added as follows: "All bends must be so made that the armor of the cable will not be injured. The radius of the curve of the inner edge of any bend not to be less than one and one-half inches."

Rule 28, section e, was amended so as to exclude flexible cord from show cases as well as show windows; the fine-print note under section g was omitted. A number of minor changes were made in the rules governing the wiring of theaters, principally in inserting the words, "or armored cable," so as to permit the use of the latter as an alternative to rigid conduit. The other changes have to do with the details of construction, fitting, etc. Among the miscellaneous suggestions adopted were the following: All self-fastening knobs, cleats and supports must be secured by suitable screws; wires in molding must be in continuous lengths from outlet to outlet or from fitting to fitting; sockets or rosettes cannot be used to dead-end a circuit; soap-stone can be used as an alternative for slate or marble; and ends of flexible wire need not be soldered before insertion under binding posts, as called for in rule 14, section c.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CONDUIT BOX, FLOOR OUTLET.

Iron box, brass floor plate and nozzle. Cat. No. 100. Approved March 20, 1908. Manufactured by

Arthur Frantzen Co., 92 W. Van Buren St., Chicago, Ill.

GROUND CLAMPS.

"Neco" and "Griptite" clamps for rigid conduit, in sizes for ½-inch to 3-inch pipe. "Flexclamp" for Greenfield flexible steel conduits or armored cable, sizes A to E, inclusive. Approved March 20, 1908. Manufactured by

Novelty Electric Co., 50-54 North Fourth St., Philadelphia, Pa.

PANELBOARDS.

Cuthbert Panelboards, 125, 125-250, and 250 V., two and three wire, with double pole knife or snap switches and link, Edison plug or cartridge inclosed fuses. Approved March 20, 1908. Manufactured by

Cuthbert Electrical Manufacturing Co., 105-109 S. Clinton St., Chicago, Ill.

RECEPTACLES FOR ATTACHMENT PLUGS.

Surface receptacles with pull-off attachment plugs. Two-wire, Cat. No. 45,395, 25 A, 125 V; three-wire, Cat. No. 45,490, 25 A, 125-250 V. (For use with approved sub-base only.) Approved March 20, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

SWITCHES, KNIFE.

Cuthbert Panelboard Switches, 15 A, 125 V, and 25 A, 250 V. Approved March 20, 1908. Manufactured by

Cuthbert Electrical Manufacturing Co., 105-109 S. Clinton St., Chicago, Ill.

CONDUIT BOXES.

"Unilets" cast-iron outlet boxes with threaded openings for ½ to 3-inch rigid conduit. With covers of stamped steel or porcelain, or with porcelain bushings. Types 1-12 and 14. Approved April 13, 1908, for exposed work only. Manufactured by

Appleton Electric Co., 224 Washington St., Chicago, Ill.

FIXTURES.

"Oamco" show window reflector. Cat. Nos. 655, 655A, 655B, 655C. A metal trough lined with glass reflectors and fitted with approved lamp sockets carried on cast-iron arms bolted to iron pipe containing wiring. Approved April 13, 1908. Manufactured by

Overbaugh & Ayres Mfg. Co., 232 South Clinton St., Chicago, Ill.

LAMP ADJUSTERS.

"Gem" Lamp Adjusters, styles A and B. A pulley-wheel mounted in iron bracket, wheel controlled by locking mechanism so as to permit the adjustment of a pendant lamp hung from a porcelain knob secured to device. Suitable for use with flexible pendant cord. Approved April 13, 1908. Manufactured by

Gem Mfg. Co., 467 Eleventh Ave., Milwaukee, Wis.

MISCELLANEOUS.

Mercury Arc Rectifiers for converting alternating to direct currents; outfits supplied for A. C. circuits of 110-220 and 330 volts with D. C. current capacities up to and including 50 Amps. (For Telephone Battery Service this apparatus may include G. E. Type A Transformer of unit ratio, to be inserted as insulation between A. C. circuit grounded neutral and ground return of the telephone system.) Compensating reactance case must be mounted on base of slate or over non-combustible insulating material when installed on floor or wall of combustible material. Approved April 13, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

M. S. Cord Grip. A fibre disc for use in socket and attachment plug caps, rosettes and similar devices, replacing knot in flexible pendant cord. Approved April 13, 1908. Manufactured by

Marshall Electric Mfg. Co., 301 Congress St., Boston, Mass.

RECEPTACLES FOR ATTACHMENT PLUG.

Surface receptacles, with pull-off attachment plug. Three-wire, Cat. No. 45,490, 25 A., 125-250 V., for use only with approved sub-base. Two-wire, Cat. No. 45,395, 25 A., 125 V. Approved April 6, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

Surface Receptacles, 20 A., 25 V. Cleat concealed and moulding types, Cat. Nos. 5,567 to 5,569, inclusive. Flush Receptacle, 20 A., 250 V., Cat. No. 5,551. Approved April 13, 1908. Manufactured by

Harvey Hubbell, Inc., 35 Organ St., Bridgeport, Conn.

Lang stage receptacle and plug, 125 and 250 V. Base of single piece of hard porcelain or alberene stone. Hardwood plug for stage cable. For use in suitable iron or steel box. Approved April 13, 1908. Manufactured by

J. Lang Electric Co., 116 N. Lincoln St., Chicago, Ill.

Russell stage pocket and plug, Cat. No. 13, 50 A., 125 V. Receptacle with porcelain base mounted in suitable cast-iron box. Plug of red fibre provided with fibre clamp replacing knot in cord. Approved April 13, 1908. Manufactured by

Russell & Stoll Co., 48 Cliff St., New York, N. Y.

RECEPTACLES, STANDARD.

Bryant Receptacles, 3 A., 250 V., Sign, Cat. Nos. 1,700 and 46,749. Cleat Cat. Nos. 9,402, 9,403, 921, 1,011, 1,123, 50,715, 11,221, 28,795, 58,949, 58,300, 58,301. Concealed, Cat. Nos. 50,744, also 9,447, fusible 2 A., 125 V. Moulding, Cat. Nos. 42,453, 58,302 and 58,950. Conduit box, Cat. Nos. 9,514 and 9,397. Rosette receptacles, cleat and concealed types, fusible, 2 A., 125 V., Cat. Nos. 9,434, 9,436, 9,438, 9,404, 9,405 and 9,406. Approved April 2, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

Porcelain shell, keyless, 3 A., 250 V. Cleat type, Cat. Nos. 28,794, 28,795 and 11,221. Concealed type, Nos. 50,744 and 50,717. Conduit boxes, Nos. 9,397, 40,537, 49,354 and 9,514. Sign receptacle, No. 46,627. Wall sockets, brass shell, key, 50 C. P., keyless, 3 A., 250 V. Concealed base, Nos. 9,184, 27,743, 29,404, 9,185, 27,743 and 29,405. Angle base, Nos. 50,753, 28,721, 29,406, 50,755, 28,722 and 29,407. Approved April 13, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers.

Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

Vol. XX MAY 2, 1908 No. 18

EDITORIAL.

MANUFACTURING OPPORTUNITY.

The first half century of Western development was accomplished without the aid of cheap fuel. This lack was really a blessing in disguise, for it applied the needed spur that finally forced the utilization of its protean water powers. But with the development of its latent oil resources there became available a fuel whose cheapness and convenience should enable the West to compete in the manufacturing field.

There has been no factor of greater use and with less recognition, in this attainment, than the aid given by the engineer. The first and most pressing problem was the taming of the furious force of newly tapped gushers, so as to regulate and control their flow with reference to reservoir capacity. But so irresistible were some that they could no more be restrained than can the waves of the ocean. Millions of barrels flowed to wanton waste. Earthen barricades were hastily built around open pools, and considerable oil was thus preserved, only to be flooded into an unready market, whose demand was not sufficient to absorb the sudden oil supply. Nor were the existing means of transportation suitable.

Here, indeed, was work to be done. How quickly a market was created is indicated by the fact that in 1906 the local consumption was greater than the production. This was due to an accumulation caused by low prices, the average being less than twenty-five cents, and the minimum ten cents. A fleet of tank steamers and a pipe line across the Isthmus of Panama soon gave access to the Atlantic, and Pacific possibilities were vigorously developed, so that the demand has already doubled this price.

With regard to the crude oil, boilers and furnaces have been reconstructed so as to efficiently use the new fuel. Radical changes were necessary in order to provide increased air capacity and new means of air distribution. The very best of our engineering talent have been so successfully concerned with this problem that fuel oil is now used in nearly every steam plant on land and sea, for both stationary and locomotive use. Petroleum-enriched water gas is much superior in cost and quality to the illuminant it is displacing, and now requires considerable oil. Smelting with oil will soon be an accomplished fact in spite of many difficulties, and oil engines such as the Diesel also utilize the crude.

Following its utilization as fuel, there came its varied applications as a refined product. Gasoline and engine oils were separated for use in the various types of explosive engines, lubricating oils were distilled to make the running easier, and from the residue, asphalt was taken to meet the good roads movement. Many other varied uses have been developed for this product, including its application to roofing and weatherproofing. Chemists have found that most of the California oil, as well as that from the Texas fields, contains an asphaltum rather than a paraffine base, which thus distinguishes them from most of the Eastern oils.

Coincident with this increasing use of oil during the past decade have been the improvements in the method of carrying it. The great expense of reaching this engineer-made market demanded that cheap transportation be provided. Long pipe lines have been built, which pour the oil directly into the refinery or into ships that take it to a foreign market. One nearly three hundred miles long was constructed, but proved inoperative on account of the great viscosity of the oil. But even this difficulty has been met and overcome by an entirely new principle that promises to solve the problem, and forms one of the interesting stories the "Journal" has yet to tell.

Not less important than the engineering problems already outlined is that detailed in this issue by our friend, Mr. Clem. A. Copeland. Disastrous fires have consumed millions of gallons, and any means that lessens this needless waste is welcomed. Incidentally it illustrates the importance of studying other jobs in relation to their possible application to new problems. The adoption of long-span work required courage, which has been justified by the results. It is not our province to discuss the ethics of competitive struggles which have characterized the history of oil wherever developed in large quantities in this country. But, as long as competition endures, stagnation is prevented, and it is undoubtedly due to this stress that so much engineering ingenuity has resulted.

COMMERCIAL DAY AT THE NATIONAL ELECTRIC LIGHT ASSOCIATION

Mr. Geo. W. Williams, who is one of the best known commercial men in the country, and Mr. Frank B. Rae, of Selling Electricity, are joint editors on what will probably be one of the very interesting features of that particular part of the convention, namely: "An illustrated talk on the methods of creating demand for electricity." This will include stereoptican views showing in detail the progress of the outline and sign lighting in large and small cities.

PERSONAL.

C. K. King, vice-president of the Ohio Brass Company, is expected in San Francisco this week.

P. H. Coolidge has come from Chicago to take the management of the Western Electric Co. of San Francisco.

W. A. Blair succeeds Mr. R. L. Van Valkenberg as assistant treasurer of the Western Electric Co. Mr. Van Valkenberg will go East on May 15th.

Alonzo Gartley, General Mgr. Hawaiian Electric Co., Honolulu, is in San Francisco as a member of the Hawaiian Governor's staff, on the way East to attend the Roosevelt conference.

W. I. Otis, who has been associated with the Western Electric Co. for the past five years, severs his connection with the company on May to open an office at 111 New Montgomery St., is the representative of several responsible Eastern manufacturers.

Tracy E. Bibbins, San Francisco manager Supply Department General Electric Co., has recovered from the shock and minor injuries received in the recent wreck of the "Owl," and is receiving the congratulations of his friends on having escaped without serious injury.

James D. Schuyler, hydraulic engineer, of Los Angeles, Cal., has been appointed member of a board of engineers to investigate and report on a power plant in Japan for an English syndicate to operate the street railways in Tokio and Yokohama, and to furnish current for lighting and power of those cities.

OBITUARY

Mr. Samuel B. Rawson, president of the Dean Electric Co., died Thursday, April 9, 1908, at Elyria, Ohio.

TRADE CATALOGUES.

Holophane Reflectors for Gem, Meridian, Tantalum and Tungsten lamps are illustrated and described in Bulletin No. 6 from the Holophane Company of New York City.

Bulletin No. 21 from H. Krantz Mfg. Co., 160-166 Seventh St., Brooklyn, N. Y., illustrates and describes Standard and Water-Tight Boxes for all electrical installation purposes. This line includes floor, wall, ceiling, elevator, receptacle, switch, conduit and junction boxes, as well as boxes with plugs and receptacles for either wood, concrete or parquet floors or marine installations.

The General Electric Company, Schenectady, N. Y., in Bulletin No. 4,576, describes the Type F, Form K-3 line of oil switches for panel installation and remote control, on systems of 4,500 volts or less. The object of Bulletin No. 4,578 is to describe the essentials of the various standard controllers that are manufactured for railway service, with special reference to the operating conditions for which each type is suited. Among the controllers described are Type B, which include the necessary contacts and connections for electric braking, Type K for series parallel operation of the motors, Type L, also in the series parallel class, but which completely open the power circuit when changing from series to parallel; Type R, which are designed to control the motor speeds by means of resistance only, and a brief outline of the Sprague-General Electric Type M control system. The General Electric CQ motor is described in detail in a 16-page bulletin. This motor is for direct-current circuits, and is made up to 20-horsepower in size, and for voltages, of 115, 230 and 550. The application of the motor to linotype equipments, ventilating outfits, machine tools, etc., is also outlined. The extensive tables of dimensions, capacities, etc., in the bulletin, will be found very useful in preparing specifications.

CIVIL SERVICE EXAMINATIONS.

Switchboard Attendant (Male).

The United States Civil Service Commission announces an examination on May 6, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of switchboard attendant (male), $900 per annum, United States Military Academy, West Point, N. Y., and vacancies requiring similar qualifications as they may occur in any branch of the service. The examination will consist of letter-writing, practical questions, and experience. Applicants for this examination should be practical electricians. They should state accurately in their applications what experience they have had in the handling of both alternating- and direct-current switchboards and alternating- and direct-current generators; also experience with various meters used in measuring high-voltage currents, rheostats, transformers, and other apparatus used in a power house.

An examination will be held on May 6, 1908, to fill a vacancy in the position of assistant engineer, $900 per annum, office of the Attorney-General, Washington, D. C.; a vacancy in the position of engineer, $1,020 per annum, Freedmen's Hospital, Washington, D. C.; and vacancies requiring similar qualifications as they may occur. Applicants who have had experience in plumbing should so state in their applications, as such experience is required for the position in Freedmen's Hospital. The examination will consist of letter-writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first-class public buildings), and experience in mechanical and electrical engineering work.

GAS ENGINEERING.

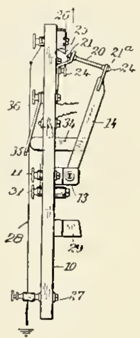
In order to meet the constantly increasing demand for training in gas engineering, four courses have been established at Cornell University. First, a course of lectures on the general theory of gas engines; second, a course of lectures on gas engine design; third, a drafting room course in gas engine design; and fourth, a lecture course which treats of the engineering problems involved in the conversion of various solid and liquid fuels into gas fuels, and in the transmission of gas fuels. This course discusses the different gas making processes and gives descriptions and studies of designs of apparatus used. The object of these four courses is to give to the student taking them the fundamental ideas of modern gas engineering.

The gas engine laboratory, which was moved into one of the small buildings in the court after the building had been rendered fireproof by concrete walls and floor, has proved a very satisfactory addition to the laboratory and will doubtless produce much valuable scientific information. It is now equipped with examples of every important type of gas engine which has been produced since the time of Brayton. A producer gas plant is being installed and will soon be in practical operation. Through the kindness of John Wilkinson, M. E., Cornell 1889, chief engineer of the Franklin Co., a four-cylinder Franklin automobile engine has been presented.

PATENTS

CUT-OUT. 884,978. John H. Booth, Frank E. Blausey, and Arthur M. Smith, San Pedro, Cal.

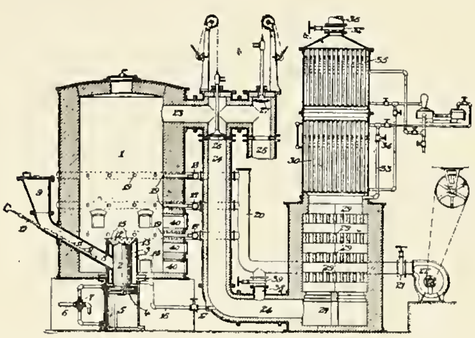
A cut-out comprising a base having a line terminal and an instrument terminal, a drop lever pivotally mounted on the base, line terminal being connected with the pivotally mounted drop lever, lever having its free end provided with a fork, a bracket



to which the instrument terminal is connected, bracket being also provided with a fork, a fuse resting in the forks, and supporting the drop lever, and a carbon block having a ground connection connected with the cut-out adjacent to the end of the fuse which rests in the fork of the bracket.

PROCESS OF MAKING GAS. 884,655. Alexander M. Gow, Edgewood Park, Pa., assignor, by mesne assignments, to the Westinghouse Machine Company.

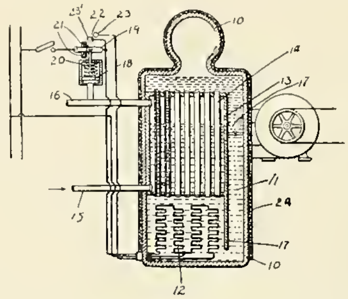
The process of making gas, which consists in blowing to incandescence the exterior portion of a body of fuel, forcing fresh fuel into the interior of the body, utilizing the sensible heat of the



incandescent fuel in the destructive distillation of the fresh fuel, introducing steam into the interior portion of the body of fuel and causing it to pass, first through the fresh fuel and then through the heated exterior portion of the fuel bed.

ELECTRIC HEATER. 884,540. Elihu Thomson, Swampscott, Mass., assignor to General Electric Company.

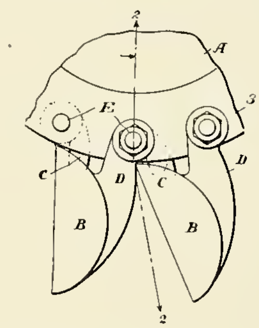
An electric heater comprising a receptacle, containing oil having a high flashing point and means for circulating the same,



a resistance conductor immersed in the oil and adapted to heat the same, and a heating system partially within the container and arranged to receive its heat from the circulating oil.

IMPACT WATER-WHEEL. 884,907. William A. Doble and Frederick Gfeller, San Francisco, Cal.

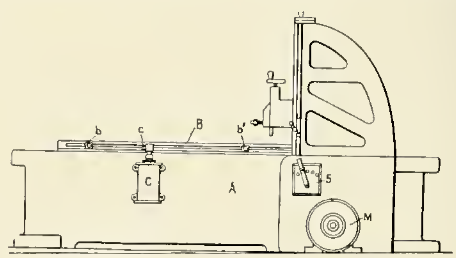
The combination with the body of an impact wheel, of buckets each having at separated points, one in advance of the other, a



central and two parallel perforated ears, the perforations of the central ear of each bucket axially in line with those of the parallel ears of the contiguous bucket, and bolts passing transversely through perforations and through the body.

SYSTEM OF CONTROL FOR ELECTRIC MOTORS. 884,541. Leonard A. Tirrill, Lynn, Mass., assignor to General Electric Company.

The method of operating a compound-wound motor, which consists in supplying current to the armature and field windings,



cutting out the armature and connecting the series field winding to the source of current supply, connecting the armature in reverse relation to the series field winding, and then inserting a high resistance in series with the shunt field winding.

THE PASSING OF A PIONEER.

In our advertising columns this week, announcement is made of the retirement from active business of the California Electrical Works of San Francisco and the continuance of that business under the name of the Western Electric Company, which has directed its operation since it assumed control in 1901.

With this change there passes into history a name so closely identified with the pioneer days that to write the history of the California Electrical Works is to write the history of the electrical business of the early days of California.

The year 1871 witnessed the incorporation of the Electrical Construction and Maintenance Company, afterward the California Electrical Works. The officers were George S. Ladd, president; John G. Ayres, business manager, and S. B. Field, electrician and secretary. Their location was on the top floor of a small frame building at the corner of Montgomery and Jackson Streets, San Francisco.

This company absorbed all the business formerly handled by outside electrical enterprise and acquired by purchase the interests of Lundberg & Marwedell, who had been carrying on a limited business in the manufacture of telephone apparatus and supplies, including the manufacture of all telegraph instruments used by the Western Union Telegraph Company on the Pacific Coast.

Previous to the incorporation of the Electrical Construction and Maintenance Company, electrical development on the Pacific Coast had been entirely confined to the operations of the California State Telegraph Company.

In the year 1863, three telegraph circuits entered the city of San Francisco, these being composed of No. 9 iron wire supported on redwood poles and insulated with hook insulators; but two of these circuits could be worked at the same time, the "cross fire" between conductors rendering a separate pole line for each conductor a necessity. In those days every trouble on the line was attributed to the fogs which were then as now very dense at certain periods of the year.

In the year 1865 the fire alarm telegraph was introduced in San Francisco, and Mr. Field was one of the operators of this system. The following year, 1866, the first private telegraph line was constructed between the offices of Kelly, Hewston & Company and their refinery about a mile away. This circuit was made of baling wire—about No. 14 plain iron—with a joint every 150 feet. The instruments, battery and dial ("A. B. C.") were from A. T. & J. N. Chester & Company of New York. The success of this line was so immediate that quite a demand sprang up for such installations, numbers of which were constructed and installed by the Electrical Construction and Maintenance Company under the supervision of Mr. Field. It may be of interest to know that these instruments cost $125 each in greenbacks, which were then rated at about 50 to 80 cents on the dollar, and were sold in San Francisco for $250 each in gold.

Housetop line construction cost $125 per mile and pole line construction about $250 per mile.

About 1874, the American District Telegraph System was introduced in San Francisco, the promoters being the various stockholders of the Electrical Construction and Maintenance Company, although the business was carried on under a separate incorporation.

On June 14, 1876, the company consolidated with Mr. Paul Seiler and Dr. Hirsch and incorporated under the name of the California Electrical Works, changing their location to the third floor of a brick building on Sutter Street.

In the year 1877 the telephone was introduced on the Pacific Coast, the first exchange being opened in the District Telegraph office on Sansome Street, San Francisco. In the summer of 1878 the first long-distance telephone line was constructed for the North Bloomfield Gravel Mining Company and various other adjacent claims commenced at French Corrall in Yuba County. It extended to nearly the summit of the Sierra Nevada Mountains, the total length of the line being about sixty miles with twenty-four stations. This line was installed by the California Electrical Works, the principal work being done by Mr. John O'Neil. In this connection it will no doubt be of interest to know that he is still in the employ of the company and we are indebted to him for much of the information contained in this article.

During these early years the California Electrical Works wired most of the principal buildings and residences in San Francisco, including the old Palace Hotel, the James B. Haggin residence, the Goad residence, the Concordia Club, General Colgan's residence, the Mark Hopkins' Institute, the Leland Stanford residence, the Chas. Crocker residence and many others. These names represent many of the most prominent early pioneers in California. Most of the wiring was for call bells and the wire used on the first installations was insulated with cotton braid and afterwards varnished, the work being done in the shop of the California Electrical Works.

The first drop annunciator on the Pacific Coast was installed by the California Electrical Works in the office of the Grand Hotel which was directly across the street from the old Palace Hotel. This annunciator remained in service until the earthquake and fire of 1906.

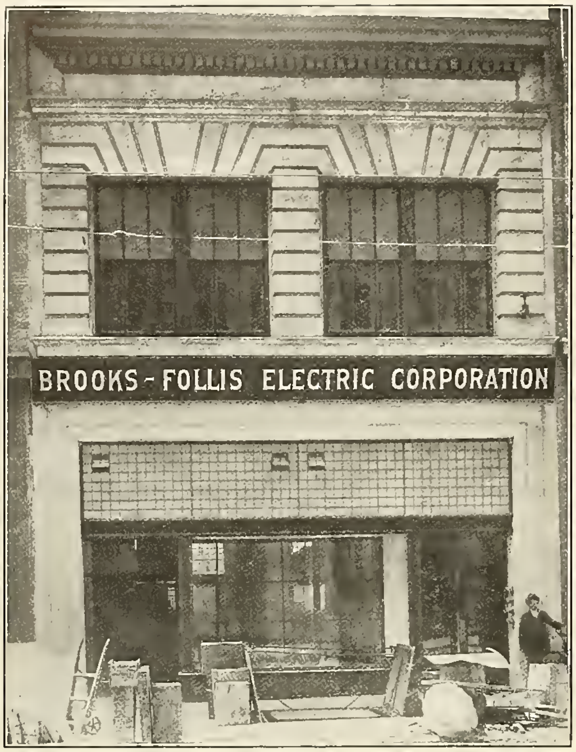
In 1877 the company installed the first electric light power station on the Coast. The old California Theater and Auction House, once so famous, was nightly illuminated with "Jarblokoff" candles. During the year 1878 the company obtained from Mr. Thos. A. Edison the first generator for incandescent lights seen in the West, this machine being one of the historical bi-polars with a capacity of about 160 lights. It was installed in the H. S. Crocker building on Bush Street, as an exhibit, and attracted a great deal of attention. The sockets for the lamps were very cumbersome and had no keys and there was only one switch on the line, this being placed on the frame of the generator. Shortly afterwards, this machine was installed as a permanent exhibit in the old Mechanics' Pavilion on Larkin Street, and as a result the California Electrical Works installed quite a number of them during the next two years.

In 1886 the business was moved to 35 Market Street, where better accommodations and increased floor space were obtained. In 1890 they again moved to 409 Market Street, where, owing to the increased volume of the business, they occupied three floors. On December 16, 1901, the Western Electric Company acquired the controlling interest in the company and located at 547 Mission Street, where three floors and a basement were occupied for offices and stock. They remained in these quarters until the completion of their present building at 642 Folsom Street, where they moved in January, 1906, three months before the catastrophe which visited San Francisco.

Farewell to the California Electrical Works. Welcome to the Western Electric Company.

BROOKS-FOLLIS AT HOME.

The accompanying illustrations show the new home of the Brooks-Follis Electric Corporation, 44-46 Second Street, San Francisco, Cal. Mr. Frank Fowden, President of the company, has clearly demonstrated what can be accomplished through



EXTERIOR.

perseverance, will and optimism in San Francisco's future.

At the time of the fire in 1906, this firm was located on Mission Street. The business was apparently demolished, but April

INTERIOR.

24th found the Brooks-Follis Electric Corporation bobbing up serenely at 563 Thirteenth Street, Oakland, where shipments were made as rapidly as material could be obtained.

In July, 1906, a corrugated iron building at 212-214 First Street, became the temporary San Francisco home of the firm, where all orders were handled to the best possible advantage under the conditions existing at that time. These quarters were acceptable while San Francisco was being settled and the business growing.

At the present central location all the electrical men from the interior can take a Market Street car and drop in at 44-46 Second Street, take a seat in Mr. Fowden's office, read the "Electrical Journals," use the telephone and make themselves quite at home.

TURBINE ACTIVITIES IN THE FAR EAST.

No less than ten machines, aggregating 25,000 horsepower, are included in a large shipment of Westinghouse turbo-electric power equipment from East Pittsburg to the Far East. Most of these machines will go to Japan for the equipment of railway, lighting, and manufacturing plants.

One of the first machines to be put in service will be a 1,500-kilowatt turbine unit for Manila, to be installed in a station with four other machines of like construction put into service several years ago. Past experience with these machines has resulted in the recent extension. It will be recalled that this railway system was engineered and constructed by the American engineering firm of J. G. White & Co.

Hardly second in importance is the large turbine station of the Osaka Electric Company, Osaka, Japan, now building. This will be one of the largest power stations in Japanese territory, and will contain, for the present, 15,000 kilowatts in five units. Three of these machines are now being shipped from East Pittsburg. The remainder will follow as fast as they can be built and tested. The Osaka installation is under direct charge of Messrs. Takata & Co., of New York and Tokio.

In the strictly manufacturing field, there are two installations in process of erection, for the Imperial Steel Works of the Japanese government and the ship yards of the Hakkaido Tanko Steamship Company. Two 500-kilowatt Westinghouse-Parsons turbo units will comprise an initial installation in each of these plants. This gratifying reception of American motive-power machinery in the Far East, especially Japan, may be regarded as an index of future operations where government inspection is exceedingly rigid and is exercised along lines much more detailed than in this country.

The General Electric Company has obtained very satisfactory results with the tungsten lamp. They have shipped over 75,000 to all parts of the country, and the breakage in shipment is below one and one-half per cent. They state that they are issuing a new bulletin covering tungsten lamps, both series and multiple, and have a large production, good stocks, and are in position to make prompt shipment, particularly of the 100-watt and all types of tungsten lamps which they have standardized.

TRADE NOTES

The American Automatic Telephone Co., formerly of Rochester, N. Y., and the Select Telephone Mfg. Co., formerly of Springfield, Ohio, are now locatedin their new plant at Urbania, Ohio, under the name of the American Automatic Telephone Co.

NEWS NOTES

POWER AND LIGHT.

Meadow Lake, Wash.—The Washington Water Power Company will build a power-house.

Eugene, Ore.—It is reported that the Willamette Valley company which supplies Eugene with electric light and power is soon to install an entirely new equipment of engines and dynamos in the generating plant at this place.

Republic, Wash.—The county commissioners granted to Arthur Phillips and H. D. Merritt franchises, each for a period of thirty-five years, to lay water mains from Deer Creek to the town of Orient, water pipes throughout the town, and for a pole line and wiring lighting the town and furnishing heat and power.

Twin Bridges, Mont.—Henry Pankey, superintendent of the Easton and Pacific mines, above Virginia City, has returned from California and will at once push matters connected with the erection of an electric power plant at Blaine Springs, which is intended to furnish electric power for the lighting of the county seat.

New Westminster, B. C.—Managing Director Buntzen, of the British Columbia Electric Railway, held a conference with the city council recently to discuss the necessity of erecting a new dam at Lake Coquitlam. Mr. Buntzen agreed that it was necessary, the present one being but a temporary affair. He will recommend the erection of a dam of the best construction to be put up this year.

Cranbrook, B. C.—The mining and general industries of southeast Kootenai will be vigorously stimulated by the fact that Wisconsin capital has now been secured to put through and fully equip the undertaking of the Bull River Power and Light Company on Bull River, near Fort Steele. The enterprise involves the production of over 10,000 horsepower of electrical energy from the river.

Lewiston, Ida.—Development of power on the Clearwater River at Lewiston is at last to become a reality. Work has begun on a power plant within the city limits of Lewiston, which will eventually develop more than 50,000 horsepower. The North Coast Power Company, represented in this field by Engineer Frank McKean and George W. Tannahill, is the concern undertaking the work, and it is understood that the power so developed is to be used for an extensive system of interurban lines connecting Lewiston and vicinity with Clarkston, Asotin, Anatone, Cloverland, and Pomeroy, and extending into the Craig Mountain timber belt and to the cement, lime, and coal deposits on the Snake River above Lewiston.

Tacoma, Wash.—With the granting of a franchise by the county commissioners to Donald Fletcher, the electric power plant to be established on the Teanaway River, at Cle Elum, in Kittitas County, is expected to be a reality. The franchise calls for the beginning of work within two years, a completion of one-fourth of it in five years, and operation in ten years. By the franchise, permission is granted to Mr. Fletcher to string his electric cable along all of the roads in Pierce County. The line will also have to pass through King and Kittitas Counties. Mr. Fletcher's plan is to build his power plant below the government dam on the Teanaway River, where he believes that at least 110,000 horsepower can be developed. The current brought from the river will be used in supplying light and power in Buckley, Puyallup, Sumner, and Tacoma, and other cities in Pierce and King Counties, according to present plans.

ELECTRIC RAILROADS.

Columbus, Mont.—There will be an electric railroad built between Columbus and Cooke City, a distance of sixty miles, and work on the proposition will commence within the next two months.

Helena, Mont.—It is possible that the Helena Light and Railway Company will expend $70,000 in constructing a new car line to the fair grounds this summer, and in purchasing cars and equipment for handling the crowds which attend the annual State fair.

Turner, Ore.—The Oregon Electric has just finished its survey from Salem to this place, and Turner people confidently expect an electric railroad in a short time. There is an impression that the road will continue on south to Albany or that a branch line will be built east into the Stayton neighborhood.

Okanogan, Wash.—The financial aid of English capitalists, who will take over an issue of $3,000,000 in bonds at 85 cents net, practically has assured the construction of the Okanogan electric railway, a road 75 miles long, which will pass directly through the Okanogan country, according to A. M. Dewey, who has offices in the Empire State Building, Spokane.

Woodburn, Ore.—A standard-gauge electric railroad will be built by the Valley Railway Company from West Woodburn to Woodburn, three miles, and thence through Monitor to Scotts Mills, and on up into the foothills to Wilhoit Springs, a health resort in the Cascades. A branch will be extended from Monitor to Silverton. Construction work will be commenced May 15.

Portland, Ore.—An electric railway company organized by Portland and Seattle men will build a line from Condon to Bend, crossing the John Day River and securing power from that stream, also erecting a dam 200 feet high in the Deschutes River and developing power there. Among those who are engineering the deal are Dr. H. I. Keeney, George C. Mason, and Mark W. Gill.

Pendleton, Ore.—An electric line from Pendleton to Irrigon, touching at Echo, Fosters, Hermiston, and Umatilla, and tapping all that vast section of country now being reclaimed by the government and other private irrigation concerns, is one of the plans of Dr. H. W. Coe, of Portland, who is promoting lands under the Furnish project. A preliminary survey has already been made. The proposed road will be a little more than 50 miles long. It will also eventually be connected with the Milton-Walla Walla electric line.

INCORPORATION.

Santa Barbara.—The Monterey Oil and Development Company has been incorporated with a capital stock of $100,000 by Santa Maria people.

Bakersfield.—The Golden Gate Oil Company has been incorporated with a capitalization of $500,000. The directors are E. D. Gillette, G. R. Neill, W. H. P. McDonald, H. Lucas, and M. S. Platz.

Santa Ana.—Articles of incorporation have been filed by the Consolidated Petroleum Corporation. The incorporators are A. W. Casey, K. A. Snyder, James McDonald, and others, all of Los Angeles. The corporation is capitalized at $1,000,000.

Modesto.—Articles of incorporation have been filed by the Tuolumne Water and Power Company. The capital stock is $1,000,000. The incorporators are Warren Gregory and H. H. Rolfe, of San Francisco; Geo. Whipple, of Alameda; Winfield Dorn, of Oakland; and J. L. Lamson, of Berkeley.

TRANSPORTATION.

Douglas, Ariz.—Douglas and Bisbee are to be connected by an interurban traction line, which is being projected by Cochise County capitalists under the name of the Cochise County Electric Railroad Company. The men interested in the project are James S. Douglas, W. H. Brophy, and George H. Neale. The capital stock is $500,000.

Walla Walla, Wash.—The County Commissioners have granted a franchise to the Mt. Hood Electric Railway Company to construct and operate an electric railway along the edge of the cemetery. The only condition attached is that the company start construction by the first of the year and have the road completed by January 1, 1910.

Los Angeles.—The City Council has passed ordinance 16,320, granting the Los Angeles Railway Company the right to construct and, for a period of 21 years, to operate and maintain a double-track electric street railroad, commencing at the intersection of San Pedro and Thirtieth Streets, thence southerly along San Pedro Street to its intersection with South Park Avenue.

Pasadena.—The City Council has agreed to turn down the request of the Pacific Electric Company for a franchise from Lake Avenue to east city limits on California Street and to turn down the proposition of the company to vacate rights to build on several streets in Pasadena, but voted to grant a franchise on East California Street for a short strip of railway between Mentor Avenue and Tournament Park, where the company has no franchise.

Klamath Falls, Ore.—The Klamath Falls Electric Railway Company is making arrangements for the extension of its street car line this summer. C. N. Hawkins and W. K. Brown, directors of the company, will superintend the work. E. R. Reames, local manager, states that the Belt Line will likely be completed, as negotiations are now under way for enough steel for the entire circuit. The old horse car will be replaced by some kind of motor.

Portland, Ore.—The announcement has been made simultaneously with the increase of the capital stock of the Oregon Electric Company from $2,000,000 to $10,000,000 that the company would begin actual construction on the first of 283 miles of extension branches and laterals to the Portland-Salem electric line, which was placed in operation within the last few weeks. The roads mapped out are from Portland to Tillamook via Hillsboro; Portland to Eugene via Corvallis; Salem to Mill City, Salem to Dallas, Salem to Albany, and Albany to Cascadia.

Woodland.—T. C. Gregory, president of the Vallejo & Northern Railroad, states that he has taken up the condemnation proceedings against the Reed Orchard Company for the large tract of land which the company wishes to acquire opposite Sacramento. The promoters of the road say that they now have all the strategic positions, and a request has been filed with the attorney-general for permission to bring suit in the name of the State against the city of Sacramento, in order to obtain the freight franchise in that city, regarding which some trouble has been experienced.

Portland, Ore.—An electric railway company has been organized by Portland and Seattle capitalists, among them being Dr. H. I. Keeny, Geo. C. Mason, and Mark W. Gill, with Eastern capital also behind them, for the purpose of building an electric railway from Condon to Bend, crossing the John Day River. A dam 200 feet high will be erected in the Deschutes River and power developed there. It is proposed to tap the coal field near Madras and serve the Oregon King gold mine, controlled by Jack Edwards, near Ashwood. The concern will be known as the Portland Construction Company.

TRANSMISSION.

Oroville.—The new Humbug Valley power plant is but one of a number of plants that the Oro Water, Light and Power Company is preparing to construct.

Placerville.—James O'Brien and Robert Duncan have filed notice of the location and appropriation of 5,000 inches of water of the main fork of the Cosumnes River, for power, mining, and irrigation.

Lewiston, Idaho.—Commissioners Salsberg and Miller have reported favorably on the application of the North Coast Power Company for a tract of ground near the water plant for a period of three years, to be used as a site for a power plant.

Chihuahua, Mex.—The Aguila Amalgamated Mining Company, which has taken over eight properties in the Hostotipaquilla district in Jalisco, is planning to erect an electric power plant on Santiago River. J. Burpee Melly, of Boston, Mass., is president of the company.

Placerville.—R. H. Sterling, manager of the American River Electric Company, is at the company's power-house near this place to inspect the recent work of repairs which has been going on at the power-house for the past two months. Four Pelton water wheels have been installed at a cost, including setting, of $10,000. The new wheels have a capacity of 6,000 horsepower and take the place of those placed five years ago. The large switchboard has also been received and other improvements made. Assistant Superintendent H. McGuirk and twenty-five men have been employed on the job.

San Francisco.—Agents of E. H. Harriman have secured valuable water rights in the Sierra Nevada and Siskiyou Mountains of California at four strategic points. Harriman is planning for the future, by means of these water rights, to generate electric power for the movement of Southern Pacific trains on various sections of its lines. The rights are located in the mountains of Kern County, east of Bakersfield; in Fresno County, east of Fresno; in El Dorado County, on the Rubicon River, and on the Klamath River, in Siskiyou County. It is stated that fully $15,000,000 ultimately will be spent in developing power at these points. The power generated on the Rubicon River will operate Southern Pacific trains between Sacramento and Reno, Nevada. When this electric power plant is completed, Harriman will have finished his proposed 35,000-foot tunnel in the Sierra Nevada Mountains.

ILLUMINATION.

Porterville.—Z. G. Peck, representing the firm of Bennison & Bruntion, Los Angeles contractors, has asked for a franchise to lay gas pipes and mains.

Portland, Ore.—The County Commissioners have granted a franchise to C. L. Pritchard for an electric light system complete for the town of Washougal.

East Newport.—Test work has commenced on the natural gas locations in the big asphaltum beds just across the bay from this point, which were filed on recently by W. W. Wilson, P. T. Evans, and Archie Sharpe, of Riverside, and Lew W. Wallace, of Newport. If the supply of natural gas is found to be sufficiently large to warrant it, a plant will be established and pipe lines will be run to Newport and East Newport for lighting and cooking purposes.

THE

Journal of Electricity, Power and Gas

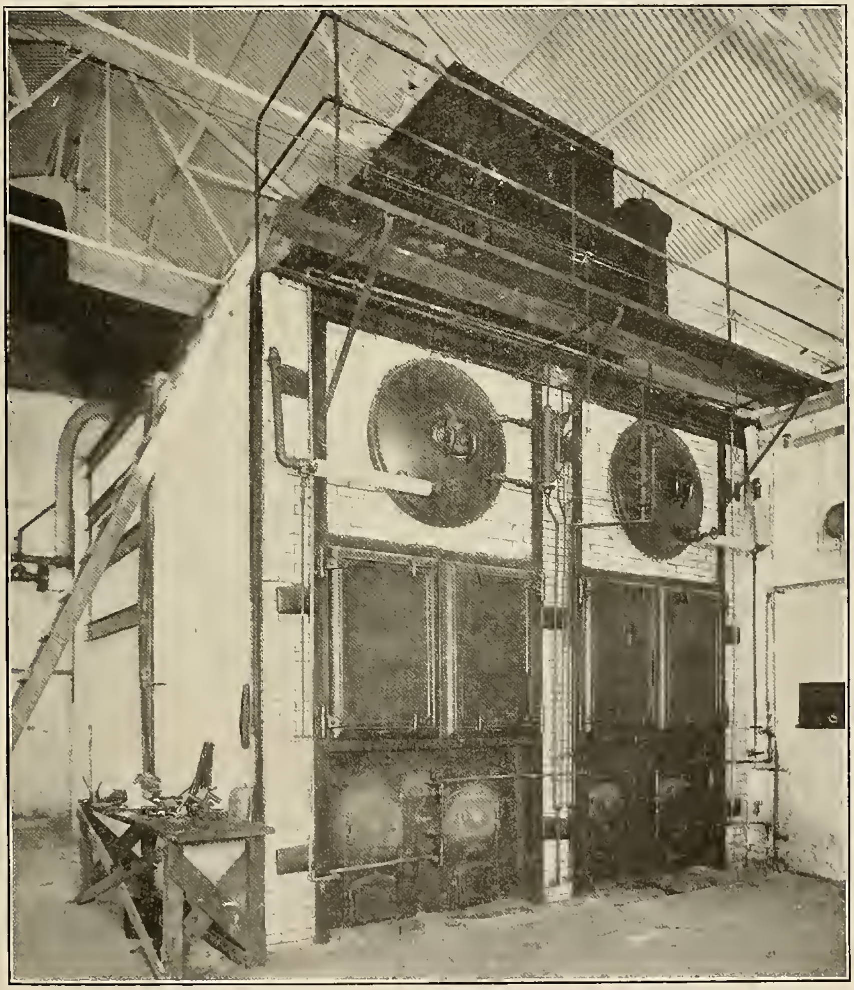
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 9, 1908 No. 19

Report of Evaporative Tests on a 200 H. P. Parker Water-Tube Boiler

By R. F. Chevalier*

The main object of these tests was to ascertain the efficiency of the boiler as being operated under commercial conditions with the prevailing furnace arrangement, and after altering same, to determine what per cent had been gained thereby in boiler efficiency, and, incidentally, at what capacity the boiler was being operated. During these tests the boiler was to maintain its operative commercial load, at the plant of the Tubbs Cordage Company, San Francisco.



PARKER WATER-TUBE BOILER

Boiler.

The boiler tested is known as "Boiler No. 2," or the "South Boiler." It is a Parker water-tube boiler, builders' rating 200 horsepower. The boiler is 12 tubes wide and 8 high, tubes being 4 inches in diameter, 18 feet long, and horizontal. There is one horizontal drum 20 feet long and 18 inches in diamater.

This drum is divided by a diaphragm of quarter inch steel plate, riveted to the shell. This diaphragm extends from the rear head to within 2 feet of the front head, and to this end and to the lower half of the drum is riveted a vertical steel plate, forming the diaphragm head, thereby making two separate chambers. In this head is a manhole, to which a cover is hinged on the inside, and when closed makes a water-tight joint. This swinging manhole cover acts as a non-return or anti-priming valve. Its function is to allow the water in the upper half of the drum to enter the lower, but to prevent any return to the former. The space between the diaphragm head and the drum head proper acts as a scale pocket. The upper half or section in the drum is known as the steam space, the lower as the water space. In the latter is a rectangular box, which is connected to the feed element by a nipple that passes through the shell directly underneath it. The feed water enters the drum through the front head and is discharged into this box by means of an internal feed pipe.

The tubes are divided into five elements. The upper or feed element acts as an economizer. It is 2 tubes high and 8 wide. Its function is to heat the feed water, which enters through the drum and is discharged into the internal box as above described, the latter having a non-return or check valve to prevent the feed water from entering the drum, thereby forcing it into the tubes of the element. This non-return valve is so arranged that, in event of the feed being interrupted or lessened, the water from the drum enters the box, enabling the circulation to continue.

The flow in the element is forward and back, alternately, through each tube in the top row, then down to the next row, finally discharging through a vertical upcast into the rear drumhead above diaphragm. The water flows along diaphragm into the scale pocket, through the swinging manhole into the lower or water chamber of the drum. The blow-off connection is made at the bottom end of the feed element, and solid water can be forced through the entire element under full boiler pressure. The lower elements, four in number, which are 6 tubes high and 3 wide, receive this heated water and convert it into steam. The water coming down from the drum enters two headers, each of which controls two of the elements, and passes through non-return check valves, which maintain a counterflow, and then on down through the tubes. The lower end of each element is connected by a separate upcast to the

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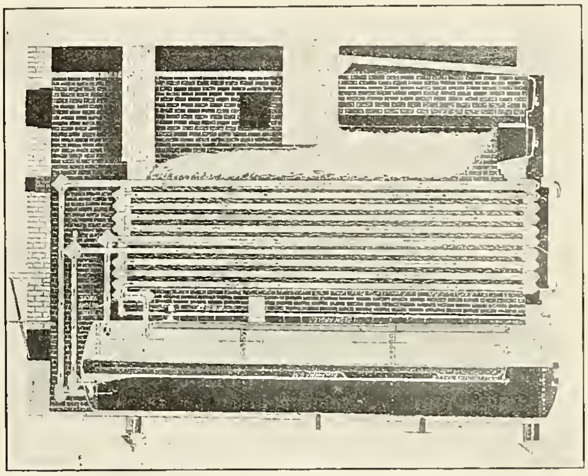
steam chamber of the drum. This steam is then led to a fitting, from which a 4-inch tube carries it down to a superheater header, and after passing through the superheater tubes, of which there are sixteen, 1¼ inches in diameter and 12 feet long, is collected in another header, from which a 4-inch tube carries it through to the stop-valve casting. There is a flooding device and a drain on the superheater element. This superheater is located on the rear of the furnace below the lower row of tubes. The heated gases of combustion come in contact with it at a very high temperature, as only a small percentage of the heating surface has been traversed by the same before reaching the superheater. Two of these units comprise the entire battery. At the time the tests were made, the factory was running at two-thirds capacity, therefore only one boiler was being operated. Both boilers are operated when the factory is running full.



PARKER WATER TUBE BOILER SHOWING WATER CIRCULATION WITH FEED DIRECT TO ELEMENT.

The Furnace.

Is of the ordinary type such as used foı coal burning. On the grate bars were placed whole fire bricks, laid in loosely to allow the admission of air for combustion. This arrangement did not conform to any standard. The flame was long and narrow, spreading at the rear of the furnace directly under the opening of the first pass.

Alterations to Furnace.

Consisted in rearranging the loose brick on the grate bars. The whole fire bricks were replaced by soap bricks, so that the air entering might be better distributed. The long flame was changed to a short one, spreading as it left the tip of the burner, and coming in contact with the vertical side walls of the furnace within three feet of the front. With the long flame, the superheater tubes were walled in with fire bricks, as the superheat was too high otherwise. When the short flame was adopted, this wall was removed and a checker work placed in front of the superheater in order to protect it from the direct impingement of the flame. A wall of loose fire brick was built on the sides of the furnace in order to protect the original walls from the action of the flame. The area, consequently the volume, in the front of the furnace was increased by lowering the grate bars and adjoining brick work, thus forming a pit, which rises again to the original level of the furnace at a point near the superheater.

Dimension and area of furnace and air setting as altered are shown on attached print, plates No. 1 and 1A.

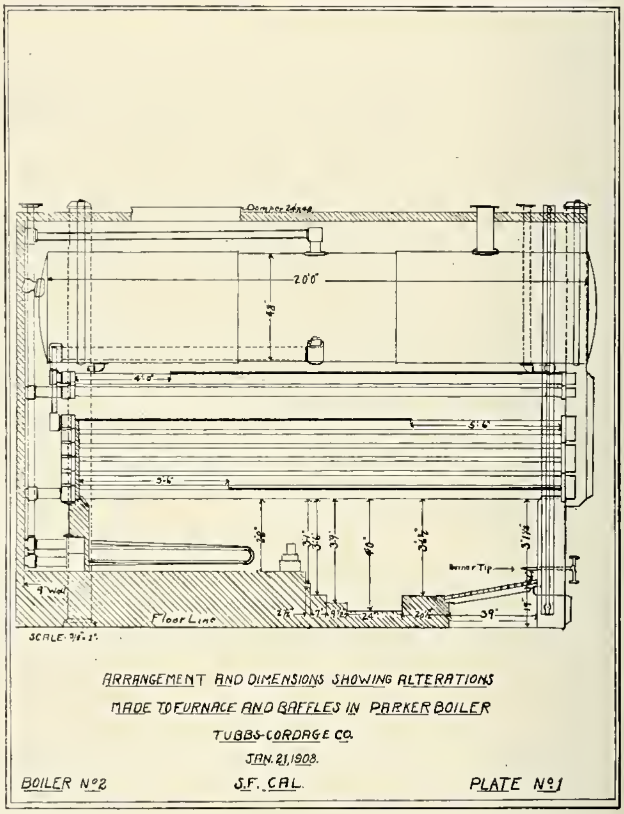
The Burner.

Is of the internal-mixing type known as the "Owen's." It is divided into two channels; the upper one contains the oil; the lower, the steam. At the end of these is a plate having small perforations, the larger number or greater area of perforations being on the bottom where the steam passes through. After the oil and steam leave this plate, they enter a hollow tube or pipe, which is used as a mixing chamber, at the end of which is a slot whereby the mixed oil and steam pass into the furnace in a fan-shaped flame.

Water-Heating Surface of Boiler.

The heating surface was determined by actual measurement. All surfaces of the boiler in contact with water on one side, and flame and hot gases on the other, were taken into consideration, and are tabulated below.

Diameter of tubes, 4 inches; circumference, 1.05 feet.



Tubes in First Pass.

1 high, 12 wide, 16½ feet of tube exposed to gases.
Area of one tube, 17.32 square feet.
Area of twelve tubes....................208 sq. ft.

Tubes in Second Pass.

5 high, 12 wide, 17½ feet of tube exposed to gases.
Area of one tube, 18.38 sq. ft.
Area of sixty tubes....................1,102.2 sq. ft.

Tubes in Third Pass.

2 high, 12 wide, 18 feet of tube exposed to gases.
Area of one tube, 18.9 sq. ft.
Area of twenty-four tubes....................453.6 sq. ft.
Area of tube leading from drum to feed element . . ..9. sq. ft.

Drum.

48-inch diameter, 19 feet exposed to gases.
Area of drum exposed to gases, 237.5 sq. ft.
Area of ½ circumference of drum exposed to gases . . ..118.7 sq. ft

Total Water-Heating Surface............1,891.5 sq. ft.

Superheating Surface.

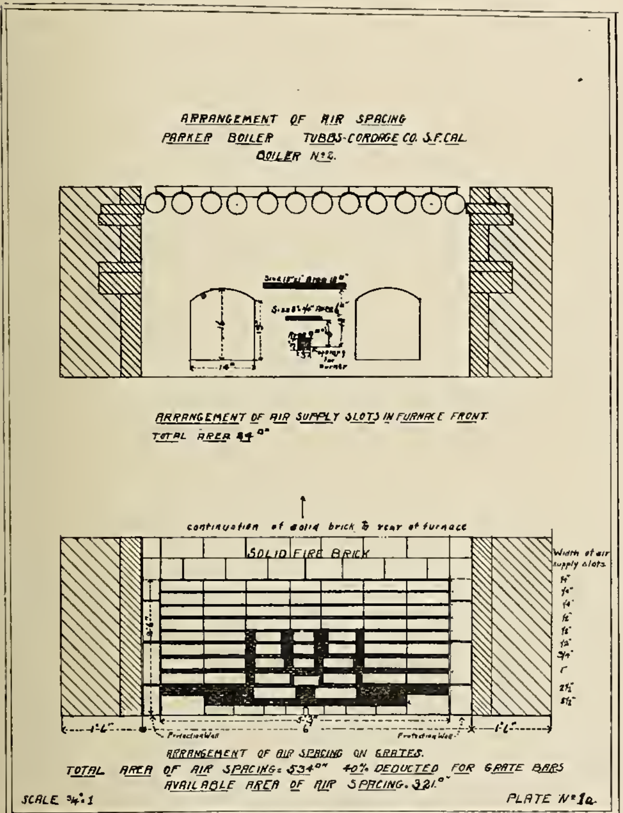
The superheating surface was also obtained by measurement, the actual surface exposed to gases being 62 square feet.

Rating of Boiler.

The builder's rating of the boiler is 200 horsepower. On this rating is based the per cent of overload. The rate of evaporation per square foot of heating surface is determined from the measurements as tabulated above.

Quality of Steam.

Superheated. Observations of the temperature of the superheated steam were taken by a thermometer placed in a well situated in the main steam pipe line, a short distance from the boiler stop valve. As will be noted, this temperature remained nearly constant throughout variable load conditions of the boiler, the extreme variation being 12 degrees F. throughout a range of 40 boiler horsepower. Reference to the steam table had to be resorted to in order to determine the normal temperature of the steam due to the average observed gauge pressure during the test, as after the test when the fire was extinguished the superheat did not disappear, though the pressure dropped below the observed average. In the calculations for the quality of steam, the specific heat of the superheated steam was assumed as forty-eight hundredths (.48).



AIR SPACES SHOWN IN BLACK.

Apparatus for Handling and Weighing the Feed Water.

The feed water was taken from the cooling tower by gravity and weighed in a barrel placed on a pair of standardized platform scales. The scales were placed on the top of the hot well, and the water, after being weighed, emptied therein. When the test was started, the level of the water in the hot well was noted. The level was maintained at the end of each hour as well as at the end of each test. From the hot well a belt-driven duplex pump took the water and fed it through a closed heater to the boiler. The water level in the boiler was maintained constant, this being facilitated by a by-pass valve placed in the feed pipe before the water entered the heater, the discharge from this by-pass valve leading back to the hot well. This valve was regulated by the fireman so that a constant level was maintained. As the only other connection in the feed line was the discharge from an auxiliary pump, possibility of any leakage occurring was guarded against by having a drain open between this pump and its discharge valve. The outlet of the blow-off and the drains from the water column and gauge glass were in plain view. They were carefully watched, no leakage occurring from either one of these points.

Apparatus for Handling and Weighing Fuel Oil.

This consisted of a pair of standardized platform scales, on which the weighing barrel was placed and the supply of oil pumped from the storage tank into same as required. From this barrel the oil was run by gravity into a second barrel, from which it was taken by a pump, passed through the heater, then to the burner. This oil pump was fitted with an automatic relief valve, by means of which a constant pressure was maintained in the oil line to the burner. The discharge from this relief valve led back to the barrel from which the suction of the pump was taken. As the oil was discharged from the weighing barrel, a small sample was collected. This operation occurring twice an hour, the sample collected represented the average quality of the oil used during the test.

Steam for the Burners.

The amount of steam used by the burner for atomizing the oil was determined only in test No. 5, as the apparatus for securing the necessary data had not been arranged for test No. 1. This steam was passed through an orifice on either side of which was a steam gauge. During the test these gauges were read every fifteen minutes. When the test was completed, steam was passed through the same orifice, under duplicate conditions, and condensed. The condensation was weighed, thus obtaining the average weight per hour. This was saturated steam taken directly from the drum of the boiler.

Heat Value and Characteristics of the Fuel.

The heat value of the oil was determined with a Parr calorimeter. Three tests were made of each sample, and the average results taken.

In order to determine the percentage of moisture in the oil, 100 cubic centimeters were placed in a distillation flask and gradually heated to a temperature of 150 degrees Centigrade. The distillate collected in a graduated tube, and the resulting water was measured. The gravity was determined by a hydrometer, Beaume scale.

The above determinations were made by the writer at his laboratory.

Instruments Used in Tests.

The boiler room steam gauge was compared with a test gauge, and found to be correct. All thermometers were correct, the same being calibrated by the writer periodically. Both flue gas thermometers were alike when compared.

Flue Gas Analyses.

Analyses of the gases of combustion were made during each test in order to determine the relative values of the air spacing in the furnace. The Orsat apparatus was used, and determinations of carbon dioxide and free oxygen were made, and only a few of carbon monoxide, as in rare cases was any of this gas present, and then only a trace.

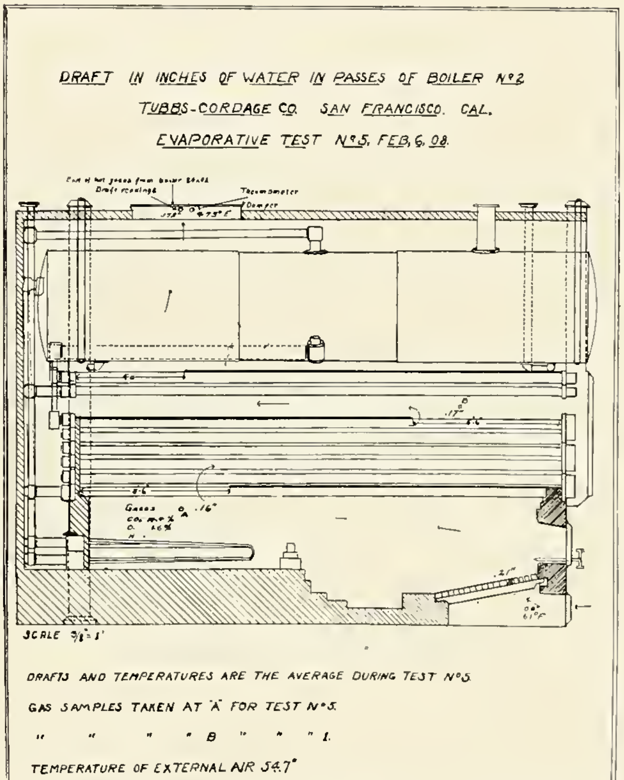
Although the object of rearranging the furnace was to decrease the amount of excess air entering for combustion, thereby increasing the percentage of carbon dioxide, attention is called to the fact that in test No. 1 samples of gases were collected from the front of the boiler in the second pass. In test No. 5, samples were taken at the rear of the

furnace just before the gases entered the first pass, a hole having been drilled through the brick setting for the purpose of inserting the sampling tube.

Owing to the different locations from where the samples were taken in the two tests, a true comparison could hardly be made, so, during test No. 5, in order to obtain a comparison, three samples were collected from the same location as in test No. 1. The average composition is as follows:

Average of Three Samples of Dry Gases Taken From Second Pass in Test No. 5.

Carbon dioxide	13.6%
Oxygen	2.6%
Carbon monoxide	0.
Nitrogen	83.8%
Per cent of excess air	13. %



Average Samples of Dry Gases Taken From Second Pass Test No. 1.

Carbon dioxide	11.8%
Oxygen	5. %
Carbon monoxide	0.
Nitrogen	83.2%
Per cent of excess air	28. %

Gas Passages in Boiler, Flue, and Stack.

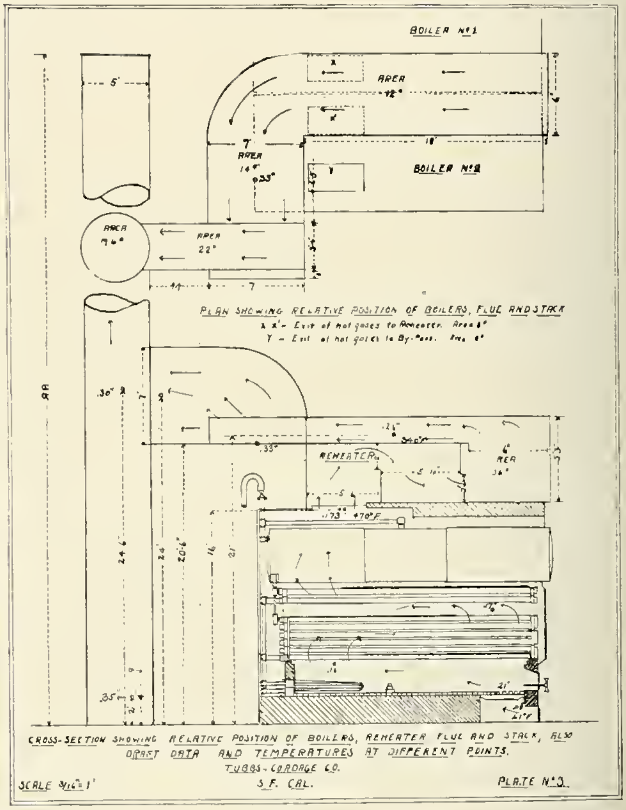
The baffles were arranged horizontally over the tubes, as prevailing in the Heine type of boiler. There are three rows of baffles, making three passes. For arrangement and dimensions, see plate No. 1.

In the flue arrangement is a reheater. Its function is to utilize the waste heat in the escaping gases from the boiler by increasing the temperature of the exhaust or receiver steam from the high-pressure cylinder of the main engine before it enters the low. This reheater is so arranged that the hot gases from the boiler pass through it, then make two right-angle turns into a flue over the reheater, doubling back to a cross flue at right angles to the reheater flue, and then make another right-angle turn into a flue leading to the stack. The height of the stack is 88 feet above boiler-room floor, diameter 5 feet. Between the boiler and the flue, over the reheater, is a by-pass used when raising steam or when there is no steam passing through the reheater tubes. For size and general arrangement of the boilers, reheater and flues, see plate No. 3.

Observations.

The following observations were taken every thirty minutes:

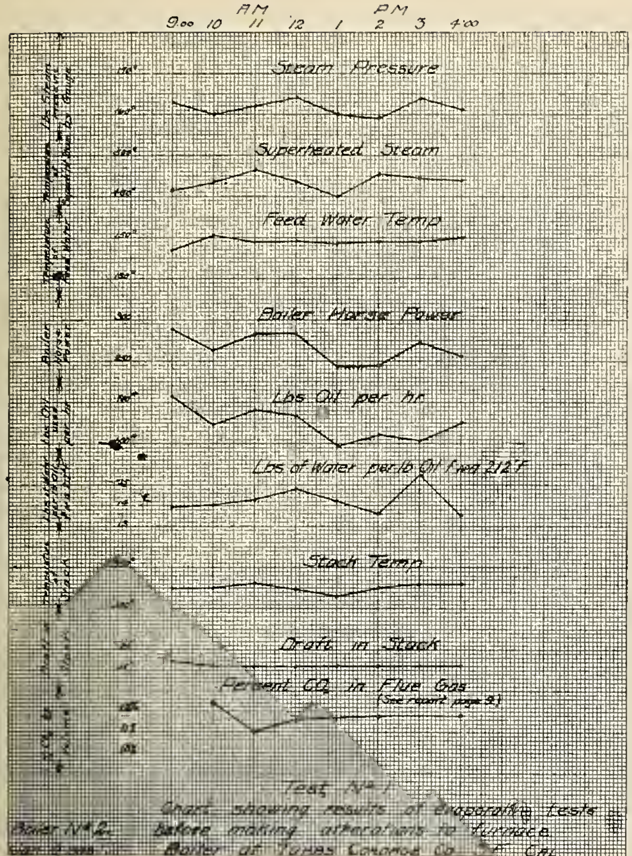
Steam pressure.
Oil pressure.
Draft pressure.
Water level in gauge glass.
Temperature of feed water.
Temperature of oil.
Temperature of flue gases.
Temperature of air entering ash pit.
Temperature of boiler room.

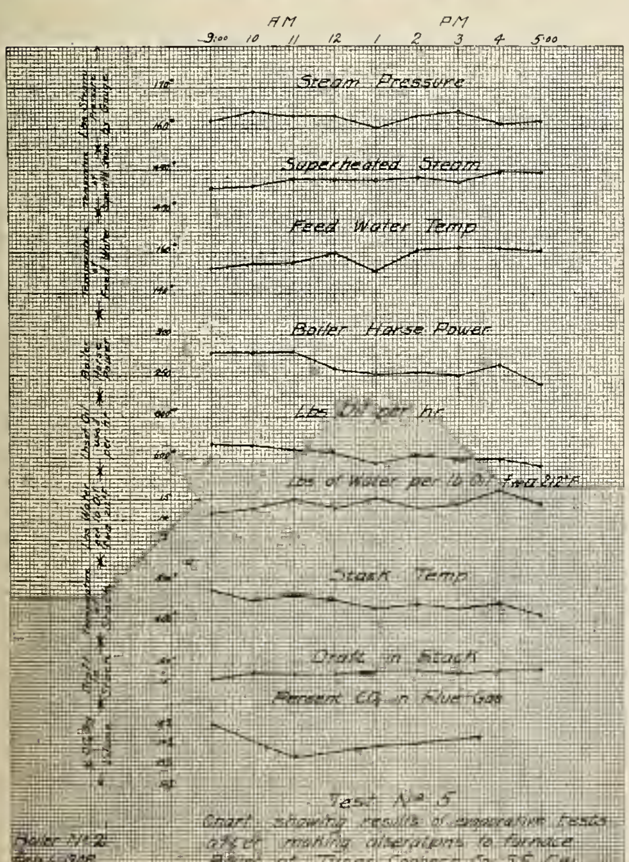


Temperature of external air.
Temperature of superheated steam.

Tests.

There were five tests made. Numbers one and five, the data of which are given in this report, are the principal ones. Tests numbers two, three, and four were preliminaries and of three hours' duration, made only to determine the relative values of the different types of flame. All the tests were made under operating conditions. Test number one was of eight hours' duration, and number five of nine hours' duration. At the start and finish of both tests the fire was maintained constant; if it had been extinguished to equalize the furnace conditions, a stop of at least three minutes would have been necessary, and this would have reduced the steam pressure considerably. The state of the fire was maintained constant for a period of five minutes before the beginning and finish of each test. The water level was measured at the beginning and end of each test and maintained nearly constant throughout the run, this being facilitated by the by-pass valve previously mentioned. Attached to this report will be found charts showing graphically the logs of the tests by which the hourly records and performances of the boiler can be noted.





DATA AND RESULTS OF EVAPORATIVE TESTS ON A PARKER WATER-TUBE BOILER, TUBBS CORDAGE CO., SAN FRANCISCO.

Tests made by R. F. Chevalier. Kind of fuel, California crude oil, Standard Oil Company's "Fuel Oil." Method of starting and stopping tests, running. Water-heating surface, 1,891 square feet. Superheating surface, 62 square feet.

	Before	After Alterations.
Date of trial, 1908	Jan. 10.	Feb. 6.
Test number	1	5
Boiler No.	2	2
TOTAL QUANTITIES.		
Duration of tests, hrs	8	9
Weight of oil as fired, lbs	5,190.	5,504.
Percentage of moisture in oil, per cent	.6	1.7
Total weight of oil consumed, corrected for moisture, lbs.	5,158.9	5,410.5
Total weight of water fed to boiler, lbs.	61,960.	68,641.
Water actually evaporated corrected for superheat in steam, lbs	66,006.	73,013.
Factor of evaporation	1.1901	1.1802
Equivalent evaporation from and at 212° F., lbs.	73,739.	81,010.
HOURLY QUANTITIES.		
Oil consumed per hour as fired, lbs	648.7	611.5
Oil consumed per hour corrected for moisture, lbs.	644.8	601.1
Water evaporated per hour, lbs	7,745.0	7,626.7
Equivalent evaporation per hour from and at 212° F., lbs	9,217.0	9,001.0
Same per square foot of water-heating surface, lbs.	4.87	4.76
Steam used by burner per hour (saturated), lbs.		276.
Steam used by burner per cent steam generated (saturated)		3.6
AVERAGE PRESSURES, TEMPERATURES, ETC.		
Steam pressure by gauge, lbs	161.7	162.9
Oil pressure at burner, lbs	78.0	100.0
Force of draft between damper and boiler, inches	0.16	0.173
Force of draft in ash pit, inches	0.12	0.08
Force of draft in furnace, inches	0.14	0.21
Temperature of external air, degrees	57.0	64.7
Temperature of boiler room, degrees	60.5	63.8
Temperature of air entering ash pit, degrees	57.6	61.0
Temperature of flue gases at damper, deg.	525.6	473.0
Temperature of flue gases after reheater, degrees	352.3	319.0
Temperature of superheated steam, degrees	487.0	484.0
Temperature of steam before superheater corresponding to pressure on boiler gauge, degrees	371.0	371.7
Number of degrees of superheating, degrees	116.0	112.3
Temperature of feed water, degrees	147.8	155.3
Temperature of fuel oil at burner, degrees.	130.0	130.0
Average water level above bottom of glass, inches	6.	6¾
BOILER HORSEPOWER.		
Horsepower developed A. S. M. E. rating, b. h. p.	267.	260.8
Builder's rated horsepower, b. h. p.	200.	200.0
Per cent of builder's rating developed, per cent	133.	130.0
ECONOMIC RESULTS.		
Water apparently evaporated under actual conditions per pound of oil as fired, lbs.	11.93	12.47
Equivalent evaporation from and at 212° F.— Per pound of oil as fired, lbs	14.2	14.71
Per pound of oil, corrected for moisture, lbs.	14.29	14.97
EFFICIENCY.		
Calorific value of dry oil per pound, B. T. U.	18,363.	18,409.
Efficiency of boiler based on oil corrected for moisture, per cent	75.1	78.6
COMPOSITION OF FLUE GASES.		
Carbon dioxide by volume, per cent	11.8	14.2
Carbon monoxide by volume, per cent	0.0	0.0
Oxygen by volume, per cent	5.0	1.8
Nitrogen by volume, per cent	83.2	84.0
PROPERTIES OF FUEL OIL.		
Gravity of oil, Beaume	16.2°	16.°
Percentage of moisture, per cent	.6	1.7
Calorific value of dry oil, B. T. U.	18,363.	18,409.
PER CENT GAIN.		
Gain in efficiency, per cent		4.5

Remarks.

In conclusion, attention is called to the fact that this boiler is not operated under conditions conducive to high efficiency, as the factory is started at seven o'clock in the morning and run until noon, and shut down for three-quarters

of an hour, then again started and closed down at five o'clock, when the fires are extinguished. This causes the brick walls to cool off considerably, and the heat thus lost must again be absorbed during the day's run. Throughout the tests, the regular fireman operated the burner. No more than the usual attention was given to the cleaning of the soot from the tubes, which is blown off in the mornings by a steam jet.

Attention is called to the constant overload on this boiler, also the variation of the load. The latter in itself is detrimental to high boiler efficiency. It will also be noted that the draft at the damper is very small, having only sixteen to seventeen hundredths of an inch (3/16 inch) of water, observations of which were made with an Ellison draft gauge.

The internal surfaces of the boiler were thoroughly cleaned before test number one, and the boiler was not opened again until after test number five was completed. The boiler had been operating five days from the time of cleaning when test number one was conducted, and twenty-one days at the time of test number five. After the last test, the boiler was opened, and a slight coating of scale was found in the bottom row of tubes, thickness of same being less than one thirty-second of an inch (1/32 inch). All the other tubes were clean. No scale nor soft mud was found in them. It had been deposited in the scale pocket.

RELATIVE VALUE OF COAL AND OIL USED AS FUEL.

By R. F. Chevalier.

The relative commercial value existing between coal and oil as fuel, irrespective of the cost of handling, is shown by the following data. This data is taken from tests made on the same type of boilers ("Parker Water Tube"). The test on the boiler using coal was conducted by Prof. H. W. Spangler, at the Philadelphia Rapid Transit Company, Philadelphia, Pa.; that on the boiler using oil as fuel, by the writer, at Tubbs Cordage Company, San Francisco. The data given is taken from one of a series of tests, and shows the maximum efficiency obtained with the boiler under commercial operating conditions and a variable load. These conditions are described in the article on the report of tests in this issue of the "Journal."

As the rating of the boiler using coal is 700 brake horsepower, and that of the one using oil only 200 brake horsepower, naturally the highest efficiency would be obtainable with the former; thus the coal is favored. The coal-burning boiler was equipped with a mechanical stoker, and it is interesting to note the relative amount of steam used to operate the stoker and that used by the burner to atomize the oil.

It is also interesting to note the comparison of the compositions of the gases of combustion and the per cent of excess air above the amount theoretically required for perfect combustion by the different fuels. The per cent of builder's rating developed was practically the same, and the steam was superheated in both instances.

The coal used was fine anthracite. The oil was California crude oil as sold by the Standard Oil Company for fuel purposes, and from which the lighter hydro-carbons had been distilled. The heat value and other data pertaining to the fuel, as well as a comparison of the results and efficiencies obtained with same, are shown in the following tabulation:

FUEL.	Coal.	Oil.
Gravity of oil, Baume		16.2°
Per cent of moisture in fuel	3.9	1.5
Per cent of ash	17.87	
Calorific value by Parr Calorimeter per pound of dry fuel, B. T. U.	11811.	18099.
BOILER HORSEPOWER.		
Horsepower developed, A. S. M. E. rating	832.3	241.
Builder's rated horsepower	700.	200.
Per cent of builder's rating developed	118.9	120.
ECONOMIC RESULTS.		
Water apparently evaporated under actual conditions per pound of fuel	7.118	13.12
Equivalent evaporation, F. & A., 212° F. per pound of fuel	9.0767	15.11
Same per pound of dry fuel	9.4451	15.34
Same per pound of combustible	11.83	15.34
EFFICIENCY.		
Efficiency of boiler	82.76	81.8
Per cent of steam generated used by stoker	5.8	
By burner		3.58
ANALYSIS OF DRY GASES BY VOLUME.	Coal.	Oil.
Carbon dioxide	7.82	14.6
Oxygen	7.50	1.2
Carbon monoxide	.13	.00
Nitrogen	84.55	84.2
Per cent of excess air above amount theoretically required	50.	5.6

Assuming the cost of coal to be $4.00 per long ton, and the cost of oil to be $1.00 per barrel, the following comparisons can be deducted:

From the results as above tabulated, we have an evaporation of 222.5 pounds of water per gallon of oil, cost of this gallon being $0.024. An equivalent evaporation required 23.57 pounds of coal, at a cost of $0.042. This places the fuel value of oil at $0.042 per gallon.

SINGLE-PHASE RAILWAY.

Discussion.

By W. F. Lamme.

In the discussion by Mr. Babcock of the report of the committee appointed by the San Francisco branch of the American Institute Electrical Engineers to investigate the San Francisco, Vallejo & Napa Valley Railroad, he made statements as follows:

1. "Under starting conditions, with 65 kilowatts input into the motors at 0.38 power factor, and 2,720 volts at the motor, the line drop was 1,103 volts, and the line energy loss 69.5 kilowatts, or 51.7 per cent. Possibly this excessive line loss explains why the energy costs increase with the load factor."

2. "Under running conditions at about six hours thirty-five minutes, there was a line drop of 363 volts, an energy loss of 30.3 kilowatts on an input of 245 kilowatts to the motors, or 11.7 per cent energy loss on the line. The power factor at the care was then 0.931."

3. "Averaged over the entire cycle named, the line drop is 483 volts, the average line loss 42.6 kilowatts, with an energy input of 218.2 kilowatts, or an energy loss of 16.3 per cent."

In the first paragraph of the above quotation, the current on the trolley at starting was 63 amperes. If 63 amperes were drawn from the trolley line at the Vallejo end without any conductor in the circuit except the 000 trolley and the rails, the energy voltage loss would be less than 400 and the line energy loss less than 25 kilowatts. Therefore, there must be some error in the figure of 1,103 volts line drop and line energy loss of 69.5 kilowatts.

In order to arrive at the value of 1,103 volts line drop, Mr. Babcock must have used a diagram as follows:

If the above diagram is the one which has been used, then the error is quite plain.

The above diagram presupposes 3,300 volts on the trolley at the generator, and that there is no inductance in the line from the generator to the car. The latter presupposition is, of course, incorrect, as the overhead lines, the transformers, and the rails all have inductance, and this is especially so in the rails.

In this specific case the car was supplied by the transformer located near Vallejo, and was approximately five (5) miles from it. There is a break in the trolley line between this point and Napa, so the total load was on the transformer near Vallejo.

Reducing the high-tension transformer feeder system, the transformer itself, and the trolley system all to one diagram, we then have a double diagram, as follows:

The above diagram gives a line energy voltage loss of 195 against 1,103. That is, with 195 volts and 63 amperes, the line loss equals 12.3 kilowatts. This 12.3 kilowatts is less than 20 per cent of 65 kilowatts, the input to the car motors at starting.

In the second paragraph quoted, we are informed that, "with 245 kilowatts to the motors, the line loss equals 30.3 kilowatts, and the per cent energy loss on the line equals 11.7 per cent."

The correct values for the above make the energy line loss 25.1 kilowatts and the percentage line loss 9.3.

As to the "average over the entire cycle" referred to in the third paragraph, the average line loss is 21.9 kilowatts instead of 42.6 kilowatts, and referring this loss to the energy input of 218.2 kilowatts, we have 9.1 per cent loss instead of 16.3 per cent.

In the "Proceedings of the American Institute Electrical Engineers" for March, 1907, Mr. Babcock made a statement as follows:

"If this road had been equipped with 1,200 volts direct current, under the same operating conditions and losses in transmission as are now made, the energy per ton mile would have been 107 watt-hours as against 153 actually recorded, and the monthly cost of energy would have been reduced in proportion."

The 1,200-volt direct-current equipment is not as efficient as the same size 600-volt equipment, neither is the equivalent alternating-current equipment so efficient as the 600-volt direct current.

In the following figures it is assumed that the 1,200-volt direct-current and the alternating-current equipments are of the same efficiency.

The four-motor alternating-current equipment is heavier than the four-motor direct-current equipment. This amounts to approximately seven (7) per cent of the total weight of the car loaded and the equipment, and it therefore takes seven (7) per cent more energy at the car than a 1,200-volt direct-current equipment would take.

The generators of the motor generator sets and the line transformers make approximately two and one-half (2½) per cent difference in efficiency in favor of the direct current.

If we have the same transmission losses in the two cases, then the alternating-current equipment will take approximately ten (10) per cent more car motor energy input into the motor generator sets than the direct current will take.

In the first quotation above (third paragraph), 218.2-kilowatt alternating current was delivered to the car. This was at a point where the car was fed from a transformer near Vallejo, delivering energy back to approximately one mile from the trolley break. Therefore, this is close to the point on the trolley system where the line losses, due to the length of conductor, are the greatest. This point is the equivalent of approximately one mile from the outer terminus in case of the direct current, or, say, 13½ miles from the power-house.

With 218.2 kilowatts delivered, the line losses were 21.9 kilowatts. The direct-current equipment requires seven (7) per cent less energy at the car than the alternating current. That is, in the above case, the direct-current equipment would require 203 kilowatts at the car. With 1,200 volts on the trolley, 203 kilowatts requires 169 amperes; 21.9-kilowatt line loss with 169 amperes on the line permits only 130 volts drop.

Two 60-pound rails in parallel give a drop of 169x13.5x.044, equals 100 volts. Therefore the permissible overhead drop equals 130 minus 100, or 30 volts. To secure this 30-volt drop on the overhead construction requires a conductor equal to 4,000,000 centimeters, about $12,000 per mile, which is prohibitive in the case of such a road as this.

But let us give the direct-current proposition the benefit of the ten (10) per cent saved in the total direct-current car and conversion equipment, equals 21.8 kilowatts. Now, there is an allowable line loss of 43.7 kilowatts. This permits a total drop of 260 volts, and the overhead copper now reduces to 790,000 centimeters. There is already installed 380,000 centimeters, so there is yet required 410,000 centimeters, or $1,180 per mile additional for copper, a total of $17,000 at the time this road was built. From this we should deduct $3,000 for line transformers, leaving a total of $14,000 yet to be expended for copper in order to make the cost for power of the direct-current equipment equal to the alternating current.

The above refers to the Vallejo end of the road. At the St. Helena end, in order to make the cost at the input side of the motor-generator sets the same, it would require 1,300,000 centimeters of copper, of which 275,000 centimeters is already installed. That is, approximately $3,100 per mile, or a total of $59,000. Against this should be charged $4,000 for transformers, leaving $55,000 yet to be invested in conductor to make the direct-current energy consumption equal to alternating current.

Therefore, with 400-kilowatt motor-generator sets and equivalent four-motor car equipments and the same losses in transmission, the direct-current 1,200 volt is prohibitive on account of the cost of conductor; but if all loss differences between the alternating-current and direct-current car equipments and converting equipments be added to the alternating-current line losses, and this sum be made the direct-current line losses, still an additional expenditure of $69,000 for conductor must be made in order to bring the cost for energy direct current down to the cost for energy alternating current.

REPLY TO MR. LAMME'S CRITICISM OF MR. BABCOCK'S DISCUSSION.

By A. H. Babcock.

In making my discussion of the results of the committee's work on the San Francisco, Vallejo and Napa Valley Railroad installation, I used the data furnished by the committee. It appears that there are other ways of interpreting the results of their work. I do not care to argue the elements of vector analysis or to enter into an academic discussion of any matter

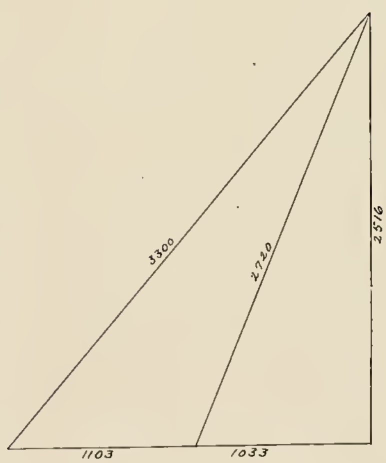


FIG. 1.

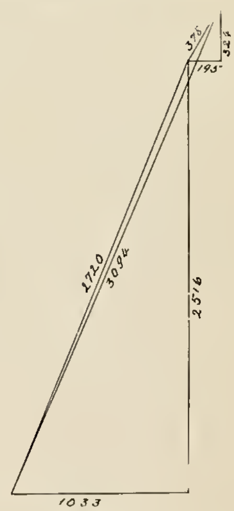


FIG. 2.

where the conditions precedent are capable of various interpretations, because by assuming a suitable interpretation of conditions any desired result may be reached. In any event, what is the use? The facts are that the cars are now operating at about double the energy cost per car-mile for which they could be operated under other conditions. It appeared to me from the committee's results that the difficulty lies in the line, and by the line is meant all the apparatus between the car and the source of supply of power. Mr. Lamme has decided that it is not in the line. The only other possible location is in the car equipment or the motors. If he would rather have it there, I am perfectly willing.

THE JOURNAL OF ELECTRICITY
POWER AND GAS

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager
A. H. HALLORAN, Secy. and Managing Editor

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R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.
Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MAY 9, 1908 No. 19

EDITORIAL.

STEAM FROM FUEL OIL.

The potentiality of Pacific petroleum for steam generation, much less its actuality, has not yet even trickled to the Atlantic intellect through the ordinary pipe lines of communication, should we accept the editorial comments of the contemporary technical press as a criteria. The cumulative advantages of cheaper handling, smaller storage, ashless burning, and perfect pressure control are met by arguments, antiquated and narrow, of alleged supply shortage, high cost, and waste of steam.

The last-century contention that the "entire oil production of the country would not keep the Pennsylvania Railroad going," is too old and feeble to long dam the present annual production of 130,000,000 barrels. This is being augmented by extension in area and an increased daily production in the Mid-Continent and California fields, which more than compensate for the decrease in the Coastal Plain and Appalachian fields. Of course, the supply is not inexhaustible, nor is that of coal, but proper conservation gives promise of a steady output for the years to come, that warrants changing existing plants.

The question of cost is local and comparative. For those who pay $4.00 or more per ton for coal there is no question but what oil at $1.00 per barrel is the cheaper. We publish elsewhere an article by Mr. R. F. Chevalier, comparing two tests, each made on the same kind of boiler, under similar conditions, excepting that coal was used at one, while oil was burned at the other. Both were conducted under working conditions, without any special preparations. The comparison shows that the fuel value of oil is $0.042 per gallon when coal is assumed to cost $4.00 per ton. Its fuel cost is but $0.024 on a basis of $1.00 per ton, thus making its value seventy-five per cent greater than its cost. In the coal test, the air excess was 50 per cent, while with the oil it was 5.6 per cent. Subsequently this was reduced to less than 1 per cent. In the coal test, the automatic stokers consumed 5.8 per cent of the steam generated, while the average of the steam used for atomizing does not exceed 5 per cent, and we have several records as low as 2½ per cent. We know of no stoker, either human or automatic, that works as cheaply and as well as an oil burner.

In our endeavor to present the availability of fuel oil for power production, we must not neglect the essential changes in furnace design, necessary to give the best results. Every plant is subject to different conditions, which require a specialist's study to most effectually utilize. No wiser investment can be made than to employ a competent engineer who can read aright what is shown in the flue gas analysis as a measure of boiler efficiency. More can be learned about steam plants by the study of flue gas than by taking indicator cards. It is not what he uses, but what he loses, that should interest an engineer.

As bearing out this contention, we would refer to the evaporation tests detailed in this issue by Mr. R. F. Chevalier. By means of certain modifications in the air admission and distribution, and by changing from the long to a spreading flame, an increase of 4½ per cent was made in the boiler efficiency. Other tests showed an efficiency as high as 81.8 per cent, the best results being uniformly obtained with the spreading flame. That such has been done indicates that the same can be done for other plants that are not getting out of their fuel all that there is in it.

PERSONAL.

H. B. Vanzwoll, secretary of the Sunbeam Incandescent Lamp Company, has proceeded East via Portland and Seattle, on his return from Honolulu.

F. G. Larkin has been appointed Northwestern manager of the Telephone-Electric Equipment Company, with headquarters at Seattle, succeeding H. H. Manny, resigned.

M. M. O'Shaughnessy, consulting engineer of San Diego, has returned south after a brief visit to San Francisco. He reports business good in Los Angeles and San Diego.

TRADE CATALOGUES.

Bulletin No. 31 from the Hyatt Roller Bearing Company, of Harrison, N. J., contains matter of interest to every one concerned with the lessening of friction. It will be sent upon application.

REMOVAL NOTICE.

The Telephony Publishing Company announces its removal to new offices at 342-347 Monadnock Block, Chicago, Ill.

American Circular Loom Company offices have been established at 45 Milk Street, International Trust Building, Boston, Mass.

TRADE JOURNALS CONSOLIDATE.

The "Industrial News," of Oakland, edited by Mr. P. B. Preble, and the "Industrial News," of San Francisco, edited by Mr. L. A. Larsen, have been consolidated. Both these publications are old established journals devoted to the building and industrial activities of the bay counties, and their consolidation makes a very strong combination, both editors being well and favorably known in their chosen field.

PUBLICATIONS RECEIVED.

Volume III, No. 3, Transactions of the Illuminating Engineering Society, contains papers on "Light and Color in Decoration," by George L. Hunter; "Extension of Gas for Illumination," by G. W. Thomson; "Eyesight and Artificial Illumination," by Dr. John T. Krall, and "Daylight Illumination," by L. W. Marsh. In addition to the usual notes and reports, it also contains a list of members.

COMMERCIAL DAY AT THE N. E. L. A. CONVENTION.

One of the subjects on the program for Commercial Day (May 21) at the convention of the National Electric Light Association in Chicago, will be "Advertising," which will be handled by Mr. Chas. A. Parker, formerly editor of the "Booster," which was started by the Co-operative Electrical Development Association. An illustrated lecture will be delivered by Mr. V. R. Lansingh, dealing particularly with store illumination.

POPULAR ELECTRICITY.

Two new journals, each named "Popular Electricity," have reached our desk, one being published by the Popular Electricity Publishing Co., 1116 Fisher Building, Chicago, and the other by the Electricity Publishing Co., 12 W. 40th Street, New York City. Both present the wonders of electricity to the layman in attractive form.

EXAMINATION FOR TESTING ENGINEER.

The United States Civil Service Commission announces the postponement to June 3-4, 1908, of the examination scheduled to be held for "junior engineer" on May 6-7, to secure eligibles from which to make certification to fill from ten to twenty vacancies in the Technologic Branch of the Geological Survey, at salaries ranging from $1,020 to $3,000 per annum, and vacancies requiring similar qualifications as they may occur.

From the register established as a result of this examination, certification will be made in accordance with the ratings received on training and experience, and the salary which the eligible is willing to accept. Those who receive 90 per cent or over on this subject will be eligible for engineer positions at salaries ranging from $2,400 to $3,000 per annum; those who receive a rating on this subject of 80 per cent or over but less than 90 will be eligible for certification to assistant engineer positions at salaries ranging from $1,620 to $2,160 per annum, and those who receive ratings on this subject of 70 per cent or over but less than 80 will be eligible for certification to junior engineer positions at salaries ranging from $1,020 to $1,380 per annum. Promotions from lower to higher grades may be made from time to time at the discretion of the Department.

Temporary appointments to the position of engineering aid or apprentice may also be made from the eligible list resulting from this examination, at salaries ranging from $720 to $960 per annum.

The examination will consist of the subjects mentioned below, weighted as indicated:

	Subjects.	*Weights.*
1.	Elementary chemistry, physics, and mathematics....	10
2.	Essay of not less than 500 words on one of the following subjects (both English composition and drawing will be rated on this subject); (*a*) On a mechanical engineering subject, accompanied by drawings; (*b*) on a civil engineering subject, accompanied by drawings; (*c*) on a mining engineering subject, accompanied by drawings . . .	20
3.	Mechanics and dynamics of engineering.............	10
4.	Engineering special subjects: (*a*) Testing of structural materials, with outline of necessary observations and computations; (*b*) testing of fuels, with outline of observations and necessary computations; (*c*) mining operations, including tunneling, blasting, hoisting, ventilation, shaft sinking etc. (Ten questions will be given under each subject. Not more than one subject may be taken by any applicant)......................	25
5.	Training and experience (rated on application form)	35
	Total	100

The vacancies to be filled in the junior engineer grade are in three distinct lines of employment: (1) For testing structural materials, for which an educational groundwork corresponding to the degree of civil engineer or B. S. in civil engineering should qualify the applicant; (2) for testing fuels, for which an educational groundwork corresponding to the degree of mechanical engineer or B. S. in mechanical engineering should qualify the applicant; and (3) for the investigation in the field of methods of mining and production of fuels and structural materials and related subjects, for which an educational groundwork corresponding to the degree of mining engineer or B. S. in mining and engineering should qualify the applicant.

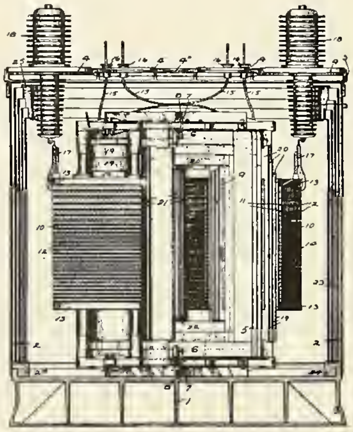
Age limit, 21 years or over on the date of the examination.

Two days will be required for this examination.

PATENTS

TRANSFORMER. 885,034. John J. Frank, Schenectady, N. Y., assignor to General Electric Company, a corporation, of New York.

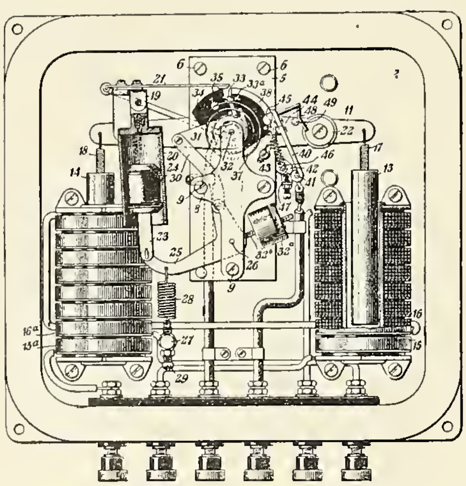
The combination with an electric device containing conductors subject to a high voltage and adjacent to other conductors or conducting material of an insulation surrounding



the high-voltage conductors composed of a plurality of parallel sheets composed of layers of an insulating material and an insulated conducting material, the sheets being successively greater in area as they are successively spaced further from the high-voltage conductors and spaces between the sheets containing insulating fluid.

AUTOMATIC SYNCHRONIZER. 885,143. Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric & Manufacturing Company.

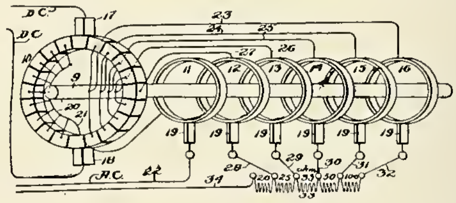
The combination with a pivotally mounted switch member



having a conducting and a non-conducting portion, a pivoted bar having a contact member that co-operates with the switch member, and means for operatively connecting the pivoted bar to the switch member, of another contact member that normally engages the conducting portion of the switch member but becomes disengaged therefrom upon movement of the switch member to an extreme position, means for thereafter maintaining the contact member out of engagement with the conducting portion of the switch member, and means operated by the pivoted bar to cause them to re-engage.

APPARATUS FOR CONVERTING DIRECT CURRENT INTO ALTERNATING CURRENT. 885,394. Frederick F. Strong, Boston, Mass.

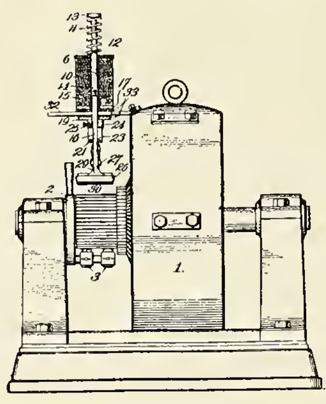
An electric apparatus for converting direct current into alternating current, comprising a rotary commutator, its brushes and feed wires for delivering direct current thereto, and an outgoing circuit including collector rings, brushes and circuit wires for conveying current from commutator, and a plurality



of resistances in series interposed in outgoing circuit, commutator having segments co-operating with brushes to cut out the feed current at predetermined intervals, and segments connected with the rheostat for gradually cutting out the resistance from outgoing circuit and gradually restoring resistance to outgoing circuit in the interval between said predetermined intervals, and means for reversing the feed current at said predetermined intervals.

COMMUTATOR WIPER AND OILER. 885,278. Daniel D. Neville, George H. Clay, and John H. Clewer, Kansas City, Mo.

The combination with a dynamo, of a solenoid having a reciprocatory plunger comprising magnetic and non-magnetic portions united together at their ends and having such union point normally within the field of attraction of the solenoid;

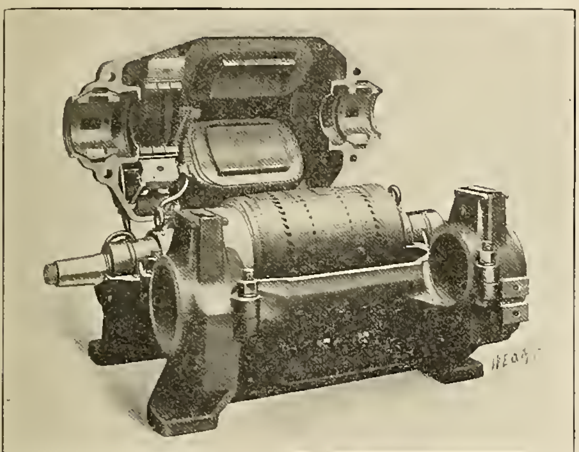


portions projecting at their opposite ends beyond the corresponding ends of the solenoid wiping and oiling means carried by the non-magnetic portion of the plunger, engaging the commutator periodically, a head on the projecting magnetic portion of the plunger, and a spring interposed between head and solenoid to hold head yieldingly away from the solenoid.

INDUSTRIAL

THE WESTINGHOUSE MILL MOTOR.

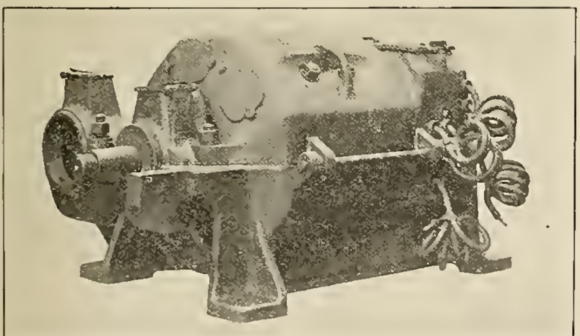
The mill type direct-current motor, which has recently been put on the market by the Westinghouse Company to meet the severe conditions met in steel mills, has been carefully designed after conferences with a large number of prominent steel mill engineers, with a full knowledge of all the electrical and mechanical requirements. The results obtained from the motors



WESTINGHOUSE MILL MOTOR WITH UPPER FRAME RAISED.

which have been tried out in service have been very satisfactory.

These motors are adapted to railroad work, for operating transfer tables, and for bending rolls in the boiler shop. The motor used on the transfer table may be provided with two friction clutches, one of which operates the drum for pulling cars or dead engines onto the table, the other the driving



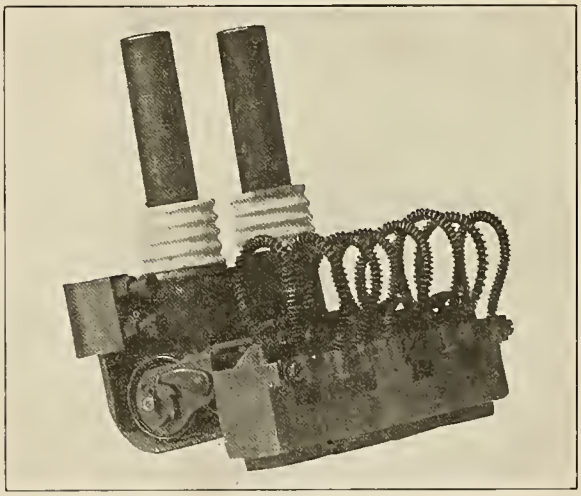
FRONT VIEW OF WESTINGHOUSE MILL MOTOR.

mechanism operating the table. As it is possible to disconnect both clutches at the same time, there may be times when there is no load on the motor, and an ordinary series motor would run at a speed sufficient to cause damage to itself. This motor, however, has a shunt field connection, which limits the no-load speed to approximately double the full-load speed, and prevents any dangerous speeds being reached.

The illustration shows the motor opened for removal of the armature. As shown, the motor frame is divided horizontally, and is hinged, allowing the upper half to be swung back for repairs in the minimum amount of time. The heavy section of the frame insures rapidity and freedom from vibration. The frame is provided with hand holes for inspection of the commutator and windings, but the covers fit tightly and the frame is dustproof. The bearing housing is extended beyond the bearing, and a dustproof construction is secured by means of a steel washer and felt lining.

The dimensions of the shaft are exceptionally large, with keyways of liberal dimensions, and all chance of bending and breaking is eliminated.

A noticeable feature of the bearings is their large wearing surface, which insures long life. The air gap between the fields and the armature is large, and allows considerable wear in the bearings before the revolving and stationary parts could rub. Special provision has been made for preventing oil from being drawn into the armature or creeping along the shaft. The bearings are split and made interchangeable for either end of



BRUSH HOLDER AND BRUSHES OF MILL TYPE MOTOR.

the motor. No dowel pins are used, as lugs cast with the bearings are used to keep them from turning. An eye bolt on each bearing permits ready handling of the armature.

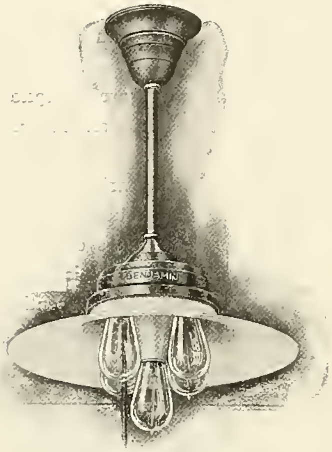
The insulation used on the motors is strictly incombustible throughout, and withstands very high operating temperature without deterioration. Only asbestos, mica, porcelain, and an insulating compound are used for insulating purposes. The coils are treated with the compound and then baked at a temperature far higher than any that will ever be met in actual service.

The carbon holder is of very substantial design, and so constructed that by the removal of one holding bolt the entire holder as one piece can be removed from the motor. The insulation is thoroughly protected from moisture and mechanical injury.

The armatures are wound with strap copper insulated with mica tape, hand wound. This form of coil can be easily repaired by the customer, which is not possible with wire-wound coils, as they are useless if the insulation becomes badly damaged. The coils are held in place by hard fiber wedges and bands, which are below the surface of the laminations.

A NEW FIXTURE FOR TUNGSTEN LAMPS.

The rapid advance of the tungsten lamps is well illustrated by the fact that fixtures especially designed for them are now on the market. Such a fixture is illustrated herewith, and the manufacturer says that it combines the best lamps with the best fixture. The fixture measures twenty-five inches over all. It consists of stem of three-eighths-inch pipe



and three-fourths-inch casing, crowfoot, wires, deep canopy, cluster body, and an eighteen-inch opal reflector. The brass base is provided with conical shape frosted aluminum reflector, which materially increases the reflecting surface of the device. The fixture is furnished with four to six lights, with or without center-lamp opening, and with or without pendant switch. It is symmetrical in outline and pleasing in appearance, and offers an effective, convenient and economical fixture for public-lighting purposes. The device is known as "Benjamin tungsten arc," and is manufactured by the Benjamin Electric Manufacturing Company of Chicago.

THE WESTINGHOUSE MACHINE COMPANY'S EXPORTS.

It is gratifying to note the continued demand from the far East for American machinery manufactured at East Pittsburg. Japanese industries are particularly active in this direction and within a recent period, The Westinghouse Machine Company has booked a large number of orders through their Japanese representatives, Messrs. Takata & Company, of New York and Tokio. Outside of turbines and gas engines, the demand for vertical compound steam engines, a characteristic of Westinghouse construction, is as active as ever.

Three 500 kw. Westinghouse turbines have been shipped to the Imperial Steel Works, Japan, and to the Hakkaido Tanko Steamship Company. The Noble School, Japan, has installed a gas engine producer plant. Four 105 horse power compound engines go to the Taragawa Electric Company, Japan, and to a private isolated plant in China. Other equipments have been ordered by the Acadia Sugar Refining Company and the Yamada Hospital.

Prescott—Water will be brought into the camp of McCracken from Cienega Ranch, and as soon as this is completed a big plant of machinery will be installed at the portal of the big tunnel which the McCracken Company is going to drive. The tunnel is to be double tracked, and two electric engines will be put in to handle the broken ore.

THE KEYSTONE BOILER WORKS.

The accompanying photograph gives an exterior view of the plant of the Keystone Boiler Works at Main and Folsom Streets, San Francisco. This building was put up soon after the fire, and has been used for manufacturing and storage since that time. The Keystone Boiler Works are the agents for the well-known Parker water-tube boilers, which have been installed

with signal success in a large number of local power plants.

This company is also equipped to manufacture boilers, tanks, and all kinds of plate iron work at short notice, making a specialty of marine and stationary boilers. Mr. J. M. Robinson is general manager, and to his genial personality is due much of the success of this company.

CANADIAN CROCKER-WHEELER COMPANY, LTD.

One of the signs of returning confidence in the business situation is the organization of the Canadian Crocker-Wheeler Company, Ltd., for the manufacture and sale in Canada of the well and favorably known Crocker-Wheeler apparatus. The Crocker-Wheeler Company, Ampere, N. J., manufactures all types of direct current and alternating current motors and generators, power transformers, motor generator sets, frequency changers, etc., some of the best known lines being direct current motors for special purposes, such as machine tool and printing press drive, and steel mill work. For the latter, a line of motors has been specially developed, which has been found to meet fully the very severe conditions which exist in steel mills. Crocker-Wheeler alternating current generators up to 2,000 kilowatt capacity have been in successful operation in Canada for some years.

F. E. Lovell, president of the new company, is a member of the old established lumbering firm of H. Lovell & Sons, of Coaticocke, Que., who have extensive interests in mills and timber limits throughout the Province of Quebec. Russell A. Stinson and F. Jno. Bell, vice-president and secretary-treasurer respectively, have been identified with the manufacturing, construction, and sales ends of the electrical trade in Canada for the past fifteen years, and are particularly well known in Montreal, where the head office of the company has recently been opened in the street railway chambers, Place d'Armes Hill.

NEWS NOTES

OIL.

Santa Barbara.—The Associated Oil Company is spending nearly $100,000 for 8-inch pipe line to connect with the 8-inch line that runs from the Santa Maria field to Alcatraz landing.

Los Angeles.—The City Council is holding over for one week two franchises for pipe lines asked for by the Union Oil Company of California. The company has a franchise over Wilshire Boulevard, which it agreed to surrender if others asked for were granted.

Riverside.—Superintendent Harwood Hall, of Sherman Institute, requested and was granted permission to lay a pipe line down Jackson Street, connecting the Santa Fe tracks to the school grounds, for the purpose of conducting distillate to tanks from the switches near Jackson Street.

City of Mexico, Mexico.—The contract for the construction of a narrow-gauge railroad, which the Oil Fields of Mexico Company will build from Furbero to Tuxpam in the State of Vera Cruz, has been let, and the work will be started immediately. The railroad is expected to be finished within 12 to 15 months, and their pipe-line contract will be let in England, but not until President Percy N. Furber goes to London.

Fresno.—Much excitement has been caused here on account of the reported strike of oil near Clovis, ten miles northeast of this city, near the Sierra foothills. High-grade oil and chunks of asphalt have been pumped from an ordinary water well two miles north of the town, and oil of a low grade has been found in a water well on another ranch two and a half miles east. As a result, ranchers in the vicinity are organizing companies to bore wells to ascertain if the petroleum can be found in paying quantities.

Los Angeles.—What is considered another move on the part of the Standard Oil Company to enter the producing business in California is the arrival of Col. J. J. Carter, head of the oil-producing department of that trust, in Los Angeles. It is said that he comes to direct the developments of new fields of the Standard in California, particularly in Monterey and San Benito Counties. The Standard continues to invest in prospective oil lands wherever opportunity offers. It has just purchased another 40 acres in Monterey County, paying $15,000 for it.

TRANSPORTATION.

Los Angeles.—The Board of Public Works is receiving bids for furnishing the city materials and supplies consisting of wire-rope tramway.

Stockton.—The City Council has passed an ordinance granting a franchise for an electric railroad to the Central California Traction Company.

Chihuahua, Mexico.—Felix Martinez, of El Paso, Texas, proposes to build an electric railroad to connect the two Mexican towns of Juarez and El Vallo.

Ventura.—Frank Packard, who with Mr. Jones, of Los Angeles, secured a franchise to build an electric road to Matilija, is in Ventura making arrangements for preliminary work.

San Bernardino.—The Board of Supervisors has granted the petition of A. G. Hubbard, of Redlands, for an electric railway franchise east on Barton Avenue from Redlands to the westerly line of California Street.

San Francisco.—The Parkside Railway franchise was passed without objection. The new franchise was found necessary in order that the route might be shifted from Nineteenth Avenue for a great portion of its length to Twentieth Avenue.

Modesto.—An interurban railway through Stanislaus County to form the nucleus for a line from the coast via Pacheno Pass to the Nevada mines by way of Mono Pass is being projected by John Hays Hammond.

Santa Cruz.—General Manager F. E. Fitzpatrick, of the Coast Counties Power Company, says that the Sequel extension will be completed to the corporate limits within the present year. Another steam turbine is to augment the capacity of the plant at the beach.

Chihuahua. Mexico.—Walter M. Brodie, chief engineer of the Batopilas Mining Company, is waiting for the materials for the aerial tramway for transporting wood and timber from the mountain down to Batopilas. As soon as the materials arrive, the middle section, about five miles long, is to be built. The tramway will be ultimately 12 miles long.

ILLUMINATION.

Gridley.—The vote on the question of a municipal electric lighting plant and water system in this town was favorable.

Pasadena.—The Beaumont Gas & Electric Company has purchased a block containing 3.75 acres in Beaumont as a site for a generating plant.

Escondido.—The stockholders of the Escondido Mutual Water Company will establish an electric light and power plant. The estimated cost of the plant is $30,000.

Ontario.—The City Council has granted a franchise to Robert Weiss to lay gas pipes in the streets and thoroughfares of this place for the purpose of carrying and distributing gas for light, heat and power.

Yerington, Nev.—The telephone system of this place changed hands last week, when J. I. Wilson bought the controlling interest in the company. An extension of the system to the new mining camps of Mountain View and Granite is one of the plans of the new management, and it is also intimated that considerable improvement along the line already established will be made.

ELECTRIC RAILWAYS.

Palouse, Wash.—The city will put in an extensive sewer system in the north side of town.

Olympia, Wash.—The city is preparing to improve a number of streets in the upper Main Street district.

Victoria.—The directors of the British Columbia Railway Company contemplate the expenditure of over two million dollars in and around Victoria. This statement was made by A. T. Goward, manager of the local branch of the concern.

Spokane, Wash.—It is reported here that the Pacific Traction Company is planning to extend its line to American Lake around to the encampment grounds on the opposite side of the lake some time this Summer.

Spokane, Wash.—The Spokane & Inland Empire Railway has applied for a franchise to construct a street car line on Mendenhall Avenue (East Riverside), which is to be an almost direct line to the gate of the Interstate Fair grounds.

Sumner, Wash.—Agents of the Puget Sound Electric Railroad Company are securing right of way for the new electric line to Seattle by way of Puyallup and Sumner. Several condemnation suits have been started, and purchases of right of way have been made outright.

Livingston, Mont.—P. A. Williams, of Chicago, has made application to the City Council for a franchise to operate in Livingston a central hot water heating plant. It is proposed to have a central heating plant with sufficient capacity to supply heat to all business houses, and a large per cent of the dwellings and public buildings.

its franchise to this part of Williams Avenue, according to an opinion given by City Attorney John P. Kavanaugh. An ordinance is being prepared by Kavanaugh to be introduced into the Council to accomplish this, because of the demands made by residents in the district affected who want the company to build or give some other company an opportunity.

Boise, Idaho.—Work has been commenced on an extension of the Boise Valley Electric Railway, from the Boise-Nampa branch to Meridian. It is expected to have cars running into that place within sixty days. Meridian is a station midway between Boise and Nampa on the spur of the Oregon Short Line that extends from Nampa, the junction, to Boise.

Puyallup, Wash.—The new short line of the Tacoma Railway & Power Company between Puyallup and Tacoma this year is an assured fact. Officials state that in view of the large amount of money already invested and the $30,000 it will be necessary to spend for material and labor before the middle of June, outside of Puyallup, it would be folly to let the road lie idle.

Billings, Mont.—An electric railroad will be constructed from Billings to Cooke City by way of Columbus, and work on the line will soon begin. The Stillwater Power Railway Company is to build and equip an electric railroad to the place mentioned, and to extend branches to Yellowstone, Sweet Grass, Carbon and Park Counties. The capital stock of the company is $3,000,000, and among the seven directors are William Bennett of Helena, and George H. Savage.

Portland, Ore.—The contracts awarded for public improvements at the adjourned meeting of the city executive board were as follows: Broadway, $749.50; Failing Street, $15,802.28; Mason Street, $18,535.98, Star Sand Company; East Eighth Street, $79.79; Curtis Street, $5,277.66; East Forty-first Street, $1,833.90; East Nineteenth Street, $5,020.69; East Twenty-second Street, $21,006.67; East Twenty-third Street, $12,081.69; Knott Street, $35,790.40, Barber Asphalt Paving Company; Haven Street, $4,430.82, Joplin & Meeks; East Sixth Street, $1,333.90; Jordan Street, $2,086.78, R. J. Debuhr; Cherry Street, $830.04, Charles E. Pottage; East Third Street, $10,212.45, Pacific Bridge Company; Broadway, $3,514.49, Charles E. Pottage; Clinton Street, $993.22; East Twelfth Street, $10,046.25; Giebisch & Joplin.

FINANCIAL.

San Francisco.—The Mercantile Trust Company of San Francisco invites bids for the sale to it on the 22d of May of a sufficient amount of first consolidated mortgage 5 per cent sinking fund 30-year gold bonds of Bay Counties Power Company for the investment of $24,897.

Vallejo.—An ordinance has been passed by the trustees, calling a special election for the purpose of submitting to the municipal corporation the proposition whether or not the city shall incur a bonded indebtedness of $85,000 in order to obtain the money necessary to defray the cost of enlarging and extending its present waterworks supply.

San Diego.—A motion is now on foot for the sale of the remaining bonds of the recent municipal issue, $210,000 worth of which have already been sold to the Staats Company, of Los Angeles. The bonds still undisposed of amount to $369,559. It is possible that the bonds sold to the Staats Company will be resold, as the matter is still in litigation and the buyers have asked for a conference. With the Staats bonds out, there yet remain to be sold bonds aggregating $369,559.

Los Angeles.—Out of the $10,000,000 Union Oil Company, the Los Angeles capitalists in control are preparing to build one of the largest corporations ever chartered in California. Its present capital will be increased to $50,000,000. For several weeks the project has been taking shape, and at the directors' meeting to be held at Oleum early in May, a plan will be reported and adopted to consummate it. The Union Oil Company has outgrown its present capitalization is the reason given for the projected increase. The company's net earnings last year were $2,080,771. The year before the annual statement showed the earnings to be $1,029,478, or less than half the dividend rolled up in the twelve months just gone by. Prior to the last meeting of the Union's directors, the proposition to increase its capital stock had been agitated, but it was only then that the first formal submission of the project was made. Already it controls nearly 214,000 acres in the Santa Maria field in Santa Barbara County; the Hartnell pool and the Stearns lease in Orange. These holdings represented an increase of 52,000 acres over the total of 1906. But following the policy of expansion the officers of the Union proposed buying another oil tract in Santa Barbara. This was approved, and a deal was closed through which the Union is now possessed of 4,000 more acres in Santa Barbara, the price paid being $450,000.

TRANSMISSION.

Placerville.—M. P. Dart has filed notice of a claim to 500 inches of water flowing in the lower Iowa Canyon for power, irrigation, and domestic purposes.

Yuba City.—An application has been received by the supervisors from the Great Western Power Company for a franchise to construct and maintain a power line across certain streets, alleys and highways in Sutter County.

Weaverville.—The North Mountain Power Company contemplates installing another power plant to supplement the one now operated by it on the Trinity below Junction City. The site of the proposed plant is at Big Flat, about eight miles below North Fork. The surveys have been made and the necessary plans adopted.

Placerville.—The supply ditch of the American River Electric Company went out three miles above the power plant on the river last week and 15 men were taken from here to repair the damage. A section covering about 100 feet in length sloughed off into the canyon. A flume will be built, which will require several days to construct, and meanwhile the water in a reservoir is being used for power. This company just spent $10,000 for repairs.

Redding.—At the last meeting of the city trustees, the Northern Light & Power Company made formal application for a franchise giving it permission to erect pole lines and stretch wires through the streets and alleys of the city for a public purpose. The company is well along with its construction work and will be ready for business by the end of the year. The Northern Light & Power Company will be the third electric light and power company in Redding, the Northern California Power Company and the Shasta Power Company already doing business there.

Wenatchee, Wash.—The Valley Power Company plans to develop a large water-power proposition on the Wenatchee River, five miles above Cashmere, 15 miles from here. The site of the power plant is near the present intake of the High Line Canal. The intake of the high-line ditch will be moved up the river a couple of miles farther to give sufficient fall, and the ditch itself will be widened and given a concrete bed. Competent engineers say that 4,000 horsepower can be developed at this place. It is expected that the company will be in a position to distribute electricity in the city by the early fall. Fully $100,000 will be expended on the plant and the work. F. M. Schoble is president of the concern and W. T. Clark vice-president.

WATERWORKS.

Hollywood.—A committee has been appointed to investigate and report on the proposition of a municipal water plant.

Bishop.—The contract for the supplies for the extension of the water system has been awarded to Leece & Watterson for $1,178.76.

Brawley.—Extensive improvements are to be made in the domestic water system for Brawley, including a centrifugal pump with a capacity of 9,000 gallons an hour on a 60-foot lift.

Oakland.—Judge Ellsworth has declared that the Oakland Board of Public Works has acted legally in accepting the bid of the Doak Gas Engine Company for the construction of a $45,000 pumping plant.

Beaumont.—The San Gorgonio Water Company has let the contract for the machinery of their plant to the Western Gas Engine Company, of Los Angeles. This company will install a 90-horsepower engine and Ingersoll-Rand compressor and air pump.

Santa Barbara.—Funds to continue work on the water tunnel which the city is driving through the Santa Inez Mountains are assured by the sale of $36,000 remaining of the old bond issue. James P. Adams & Co.. of Los Angeles, was the highest bidder.

San Francisco.—Marin County is to have an increased water supply through the plans of the Marin County Water & Power Company, controlled by A. W. Foster, A. B. McCreery, P. N. Lilienthal, and G. A. Newhall, by the installation of a reservoir with capacity of 3,500,000,000 gallons.

Kingman, Ariz.—Judge A. A. Sturgis and M. J. Spencer, of Los Angeles, have closed a deal whereby it is proposed to bring the waters of Walnut Creek to Gold Flat. A survey has been made of the proposed route, and it is found that a line 7 miles in length will be necessary. The pipe will be 10 inches, reduced to 6 inches at discharging. Colonel Morgan, who is putting in a milling plant at old Red Hills mines, is to be interested in the enterprise and will take considerable of the water for his plant.

TELEPHONES.

Reno, Nev.—The telegraph and telephone lines of the Fairview-Rawhide Telephone & Telegraph Company and the Rawhide-Schurz Telephone & Telegraph Company have been combined, and in the future all messages between Reno and Rawhide will go over one wire, and one rate will be charged. It is stated that the consolidation of the two companies will probably result in a reduction of the telegraph tolls between Reno and the new mining camp of Rawhide.

Oakland.—The United States authorities visited the offices of the Oakland Transcontinental Aerial Telephone & Power Company recently and arrested six of the promoters of what is alleged to be one of the most flagrant swindles of a decade. The offices of the company were located in rooms 203-204, Union Savings Bank Building, and the men taken into custody were Albert Janke, inventor and president; Harry P. Dwyer, vice-president; Wade H. Shadburn, secretary; Albert G. Rockel, treasurer; W. H. and J. B. Allen and Dr. R. W. Bardachy, solicitors. The concern has been under the surveillance of the police since last February, but owing to the fact that Captain Peterson, chief of the Oakland detectives, was unable to get any of the people who had put their money into the enterprise to swear to a complaint against the officers of the company, he was obliged to turn the matter over to Postal Inspector James O'Connell, who soon had sufficient proof against the men to warrant their arrest on a charge of using the United States mails to defraud.

TELEPHONES.

Spokane, Wash.—Announcement is made in Spokane by J. A. Vandyke, manager of the North Idaho Telephone Company, of Wallace, that the fight between his concern and the Interstate Telephone Company, of Spokane, both independent, for supremacy in the Coeur d'Alene mining district, east of Spokane, has come to an end. The North Idaho Company will conduct the local exchanges, while the Interstate Company will handle the long distance business, connecting with the local exchanges.

The Interstate has a line from Spokane as far as Sweeney, Ida., extending it to Wallace. Mr. Vandyke says the local exchange in Kellogg and toll office in Wallace will be opened in May, and that work on the Wallace exchange will be rushed. The Interstate Company will continue its line on to Missoula and other Montana points. The Interstate has bought a pole line from Kellogg to Wallace. The lines to Mullan, Burke, and Gem, Ida., will be in operation in October.

Farmers in the wheat belt, south of Spokane, and the Snake River, have organized the Penawawa Telephone Company, Limited, to construct and operate the most extensive system of rural telephone lines ever operated in this part of the Northwest. The officers are: Silas Smith, president; Herbert Smith, secretary-treasurer, and W. F. Adams, Niles Champlin, and Guilford Miller, directors, all of Colfax, Wash. The lines now under construction will cost $4,000. The line starts from the Pacific States long distance office in Colfax, and is strung on this company's poles as far as Plainville, four and a half miles south of Colfax, from which point there are poles erected. From Plainville to the head of the Little Penawawa, 12 miles, runs the trunk line, known as the Major's Station, there will be an office, a switchboard, and day and night operators, so that the branch line subscribers. as well as those on the main line, will be enabled to get connection with the long distance office at Colfax. To this station the line will be equipped with six metallic circuits. From the Major's Station three lateral lines leave the trunk line, one runs to La Crosse, one to Penawawa, and the other, called the Adams-Champlin line, within four miles of Almota. The La Crosse branch is 30 miles in length, carries six metallic circuits and accommodates 100 subscribers. It is the intention to eventually extend this branch to Hooper and Kahlotus. The Adams-Champlin branch is seven miles long, has one ground circuit and accommodates 10 subscribers. It is possible to switch at the Henry Hickman farm on this line, so that communication may be had with the Almota long-distance office, and also with what is known as the Moys neighborhood, over the Moys line. Penawawa line is 14 miles in length, and has two metallic circuits and connects 24 instruments.

Assessed valuation of the telephone and telegraph lines in Umatilla County, Oregon, southwest of Spokane, has doubled 26 times, while the actual length of the lines has increased from 321 to 844 miles. The lines were assessed at $20,595 five years ago, while last year the figures were fixed at $549,040. Much construction has been seen in the rural sections, connecting farming districts with Pendleton and other towns, making a network of lines connected with the long-distance system, which extends to all points of importance in the country. Some telegraph lines have been constructed along the railway between Pendleton and Pilot Rock, and in other places. Inasmuch as the telephone business has been created within the last few years, this showing is considered as almost without an equal anywhere in a country of small towns and large wheat farms.

Lower rates on two-party lines have been established by the Pacific Telephone and Telegraph Company. The new rate gives former subscribers on a two-party line an extension telephone in addition to the original instrument at the rate formerly charged for a single instrument. Until a short time ago, the company charged $2.50 a month for connection on a telephone line supplying two subscribers, and 50 cents additional for an extension phone. It now makes a rate of $2 a month for a single instrument, and 50 cents a month for the extension, supplying both instruments at the rate formerly charged for one.

Patrons of 14 farmers' telephone lines in the Nez Perce country, southeast of Spokane, decided recently to join the Nez Perce Co-operative Telephone Company. The fight has been waged between the Pacific Telephone Company and the independent concern for several weeks, as representatives of both lines have been soliciting subscribers. G. Bingham, superintendent of rural lines for the telephone company, sought to induce the farmers to join his company and as an incentive cut the monthly switching charges to 20 cents, which is 5 cents cheaper than the co-operative company performs the service.

Thirty-seven hundred instruments will be served by the Pacific Telephone Company's new sub-station at Sinto Avenue, in Spokane, to be opened in June. Preparatory to using the new exchange the company is having printed a new telephone directory, in which the telephones connecting directly with the North Side exchange will have the prefix "Maxwell." The company will build another exchange on the north side.

The Yakima Valley Telephone Company will move its exchange from Parker to Wapato, Wash. The necessary stock to effect the change was subscribed among the business men here in a few hours. S. J. Harrison, of Sunnyside, has agreed to issue stock for that amount to local business.

Charles P. Lund, of Spokane, has become owner of the telephone system at Cheney, Wash. The Pacific States Telegraph and Telephone Company owned and operated the exchange for a number of years. Last Summer, when the commercial club insisted that a better equipment should be installed and a better service rendered, the company offered to sell the exchange because they did not care to make further improvements here. The exchange then passed into the hands of W. T. Du Bois, former manager of the company. Mr. Lund will make improvements in the way of putting in new office equipment and extending the lines. It was through the efforts of Mr. Lund, who is president of the Board of Trustees of the Washington State Normal School, that Cheney secured the electric line recently completed by the Washington Water Power Company, of Spokane.

The directory just issued by the Pacific States Telephone and Telegraph Company in Spokane contains 10,700 names, although the company has 12,800 instruments in operation. This is a high percentage for a city of 100,000. The difference is accounted for by the number of firms which have more than one telephone.

Farmers in the vicinity of Forest, Ida., have organized a telephone company, and have secured permission to connect with the Nez Perce Co-operative Telephone Company, at Ilo. Several farming communities having more than 200 miles of line, with 1,000 instruments installed in the Lewiston country, are seeking service.

WATERWORKS.

Santa Cruz.—Supervisor Linscott has been authorized to purchase 3,000 feet of 1¼-inch water pipe for the Pajaro road district; also to build two new 6,000-gallon water tanks.

San Francisco.—A meeting of the stockholders of the Camino Real Water Company will be held in the Crocker Building, San Francisco, on June 22d.

Lewiston, Ida.—At a meeting of the City Council application was made for the lease of a tract of land lying along the Clearwater River near the city pumping station, to be used as the site for a temporary power plant for the North Coast Water & Power Company.

Oceanside.—The City Trustees have awarded the National Wood Pipe Company the contract for 10,400 feet of wood pipe and fittings, their bid being 29⅝ cents per foot. The Trustees have also accepted the bid of the American Steel Pipe & Tank Company for 3,400 feet of riveted pipe for the sum of $590.

Klamath Falls, Ore.—H. V. Gates, president of the Klamath Falls Light & Water Company, will be here the latter part of April to complete plans for commencement of work on additions to the system. The reservoir to be put in Moore's addition will have a capacity of 200,000 gallons, and the one at the Hot Springs will be about 300,000 gallons. Work is planned to begin in May. A large amount of new pipe and mains will be required.

Yuba City.—The Town Trustees have had Surveyor Guy McMurtry make estimates upon the cost of an up-to-date waterworks system, and, after several days' investigation, Mr. McMurtry has reported that an excellent system can be installed for not more than $25,000. This will include the construction of a steel tower seventy feet high, with concrete foundation, and an 80,000-gallon tank, six and eight inch mains laid on all the principal streets, and the installation of electric power, with steam or gasoline power as an auxiliary.

Portland, Ore.—At a meeting of the water board, City Attorney Kavanaugh was instructed to take up the city's rights on the Bull Run River with Senator Fulton to prepare an act that will insure the city absolute rights in the reserve. When in Portland last fall, he promised his support to the project, and with City Attorney Kavanaugh will draft an act to accomplish this object. Members of the board have voted for the erection of a pumping station on Council Crest to furnish residents in that vicinity with water. The station is to have a capacity of 250,000 gallons per day. Bids will be advertised for and work started as soon as possible.

Woodland.—Work on the Moore dam has been completed, and the Yolo Consolidated Water Company has commenced to supply water to those who want to irrigate. About 30 feet of water was turned into the Moore ditch the first day. This is all that is necessary for the present purposes. The volume could be increased to 100 feet if necessary. Work has been commenced on the dam for the Adams ditch and the Winters canal. The Adams ditch dam site is about a mile above Capay, while the dam for the Winters canal is about three miles above Capay. It will be two or three weeks before these dams are in such a condition that the water can be turned into the ditches.

TELEPHONE.

Bickleton, Wash.—W. J. White, of the Goldendale Telephone Company, was here lately in an effort to organize a company to construct a telephone line from here to Goldendale.

Rock Creek.—The Star Telephone Company recently held its annual meeting. The following officers were elected for the ensuing year: President, Herman Oest; vice-president, E. O. Gassaway; treasurer, William Cramer; secretary, J. W. Clarke; assistant secretary, E. E. Ridinger.

Eureka.—Manager E. A. McLaren, of the Pacific Telephone Company, of this city, has announced that a new building for the Eureka system will be constructed this spring on the company's property, located on the northwest corner of Sixth and F Streets. An expert is at present engaged in estimating the cost of the contemplated structure, and is working out plans for the new building.

San Francisco.—Chief Electrician Whorf, of the Harbor Commission, has recommended that a wireless telephone station be installed in the Ferry Building during the time of the fleet's visit. The wireless telephones on the battleships are the same as the ones to be maintained in the Ferry Building, and the shore station is required only to afford the fleet communication with the land, and is not for commercial purposes.

San Francisco.—General Manager E. J. Nally, of the Postal Telegraph and Cable Company, has made arrangements with the Southern Nevada Telegraph and Telephone Company to use the lines of the latter company in southern Nevada, and has closed a contract with local contractors to construct other lines for the Postal Company in Nevada. Manager Nally says the Postal Telegraph Company will follow the line of the Santa Fe Railroad to Rhyolite, and from that point will later extend lines into all portions of Nevada and compete with the Western Union.

ELECTRIC RAILWAYS.

Seattle, Wash.—Councilman Wardall introduced an ordinance granting a franchise to the Seattle Electric Co., to extend its street-car line to Alki Point.

Steptoe, Wash.—A corps of engineers in the employ of the Spokane & Inland Empire Railroad Company is selecting a route from the town of Steptoe to the top of Steptoe butte.

Monroe, Wash.—Actual construction work has been begun on the line of the Snohomish Valley Railroad Company's trolley road, which, the promoters say, will be built this season from Snohomish, a distance of fifteen miles to a point eight miles south of Monroe. Negotiations which have been under way for some time past have resulted in the sale of the bonds and the raising of the cash for this part of the projected line.

North Yakima, Wash.—Building of an interurban system, which will network the Yakima Valley, connecting all the principal cities and towns, is planned by the Yakima Valley Transportation Company. That the company will build seventy miles of electric railroad at an approximate cost of $2,000,000 has been announced by the men interested in the local company, who now have a three-mile road in operation over Nob Hill. A. J. Splawn, one of the pioneer ranchers of the Yakima Valley, is president of the company, and G. S. Rankin is vice-president and general manager.

FINANCIAL.

Yuba City.—The water works bond election in this place has been carried.

Santa Cruz.—Councilman Faneuf reported that the cost of a 100-light generator for the electric light plant would be $2,720.

Santa Cruz.—The City Council has decided to consider calling a $200,000 bond election for sewers, bridges, wharf, and an electric light plant.

Portland, Ore.—According to President E. P. Clarke, of the Mount Hood Railway and Power Company, they are prepared to invest from $10,000,000 to $15,000,000 in their property.

San Francisco.—The Big Creek Light and Power Company, now a subsidiary of the Coast Counties Power Company, has executed a deed of trust to the Mercantile Trust Company. A. H. Winn is trust officer.

Seattle, Wash.—The executive committee of the City Council has approved of the ordinance authorizing the issuance of water bonds in the sum of $2,500,000, and the comptroller is authorized to make all arrangements for the disposal of the securities.

Los Angeles.—The electrical contracts, totaling nearly $9,000, have been let by the City Council, on the recommendation of Manager Koiner, of the municipal electric light plant. Of the amounts mentioned, the California Electric Company gets $2,464.50; B. F. Kierulff, Jr. & Co., $5,843; and J. A. Roebling Sons' Company, $84.42.

Oakland.—Louis S. Beeby, vice-president of the Home Telephone Company, has sent to the auditing and finance committee of the City Council his report of the expenditures made by his company in this city between April 2, 1906, and April 1, 1908, and the report shows that $850,000 has been expended. Mr. Beeby states that the $850,000 has been spent by his company in the purchase of land, the erection of buildings, and the establishment of a system.

OIL.

Los Angeles.—Judge James, of the Superior Court, has made a ruling virtually sustaining the validity of the corporation franchise assessment provided for under a State law, and taken advantage of here to such an extent that many companies have moved their headquarters out of this county. The Western Oil Company sued for a refund of $10,000 taxes paid under protest, and the county demurred on the ground that the complaint did not constitute a cause of action. This the court overruled, the effect of the decision being the validation of all similar assessments. The oil company maintained that, if assessable, the franchise should have been taxed in Santa Barbara County, where its plant is situated, and that it was assessed at 1,000 times its valuation.

(Continued on second page following.)

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 16, 1908 No. 20

EVOLUTION OF CAST IRON PIPE.*

Iron and other metals were known to man in prehistoric times. Numerous references in tomb records show early knowledge of gold, silver, copper and lead, if not of iron, used in Egypt to a limited extent even in the predynastic age. Sir Henry Bassemer in 1895 adduced evidence to show that the tools used in the construction of the pyramids must have been made of a meteoric nickel-iron alloy. The theory is however open to considerable doubt in view of the difficulty of working meteoric iron. Indeed, many authorities have denied that meteoric iron is malleable. The hypothesis is nevertheless an attractive one. Probably one of the earliest references to iron is in the record of "Tubal-Cain, an instructor of every artificer in brass and iron," (3874 B. C.) and whose name, by the way, is a bit suggestive to a maker of pipe. As the world progressed, iron is more frequently mentioned; for instance, as tribute received by the Chinese, and as used by the Israelites 2000 to 1500 B. C., and later, in the centuries preceding the Christian era, by the Phœnicians, Greeks and Romans. A fable tells us that Juno was hung from the sky, with iron anvils fastened to her feet, and that Vulcan "fell all day to Lemnos," we do not know how many ages ago. Archæologists have uncovered much to show that the early Egyptians and Assyrians were skilled metal workers, but not as makers of iron pipe.

KNEE AND T JOINTS.
MADE ABOUT 4,000 B. C. FOUND IN THE EXCAVATIONS OF THE TEMPLE OF BEL, NIPPUR, BABYLONIA.

EARLIEST PIPE.

In the excavations of the Temple of Bel, at Nippur, Babylonia, Prof. Hilprecht found clay pipe, which from their location must date from more than four thousand years B. C. He tells us "directly beneath the ancient enclosing wall opened a vault about 1 m. high, built in the form of an arch. It belongs without doubt to the fifth millennium. * * * In the 'Kingdom of Nimrod' it was not necessary to tear up the pavements whenever an underground pipe burst, for this structure is not a mere subterranean canal for drainage, but an arched passage, in the bottom of which are imbedded in cement, * * * two clay pipes of about 15 c. m. diameter, alongside each other. If one of them burst, a workman crept into the vault and repaired the damage without further difficulty. * * * About 500 knee and T joints found in the vicinity show us that even at that early time they understood how to unite pipe meeting at right angles." Here we have reference to the earliest known Babylonian arch, and undoubtedly to the earliest pipe and specials known to us to-day. From the fact that such pipe and specials were used at that time, it would seem probable that the expert metal workers of those early days soon supplemented clay pipe with pipe of lead, and even of copper or brass for important services. We read of "cast pillars of brass" and molten brass," as early as 1000 B. C. We know that the Greeks and Romans used lead pipe extensively, but the knowledge of how to make such pipe probably came down to them from the Phœnicians or Egyptians of earlier times. The Delhi Laht, or huge iron pillar, and iron beams used in the construction of temples and palaces in India, and massive iron girders found in ruins at Rome, testify to the existence, several centuries B. C., (though the Laht may be of a later period) of great iron works in India and in Spain. Their product seems to have been entirely of wrought iron and steel, but apparently did not include pipe. Among the bloomeries of early times we do not find any with a pipe foundry annex. Iron castings or rather "fused iron forms," Aristotle (359 B. C.) tells us, were not then commercially made, and indeed until five or six centuries ago were apparently scarcely known at all. In these days of iron and steel, with all our hurry and pressing demands, we seldom stop to think of the wonders wrought two, three and even four thousand years before Christ, or to credit the civilization and culture of the people of those far away days, with certain influences felt to-day.

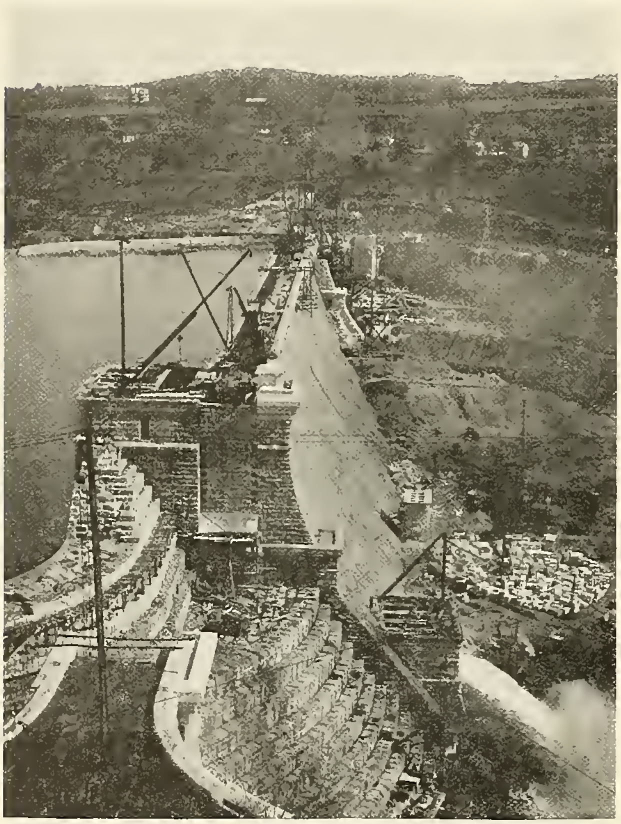
AN OLD ROMAN AQUEDUCT.

WATER SUPPLY CONDUITS.

Probably the earliest artificial conduits were the canals and other surface waterways of comparatively level ancient Egypt and Babylonia. Some of them were large undertakings, but especially in Egypt were constructed with a view mainly to irrigation and also for navigation, rather than as conduits of water for domestic supply. The early Egyptians were famous for their dams, dikes and canals, and for their ingenious

*Contributed by R. W. Martindale.

though primitive methods of raising water. They made brick and built treasure cities, and, as suggested, probably made pipe of baked clay, but we read of wells and water jars rather than of pipe. Memphis and Thebes had the Nile, but what of the distribution of their domestic water supply? Glancing farther east, on the site of old Jericho may be traced several conduits and a reservoir. Damascus, that city without a known date, early had its conduits. At Jerusalem, about 1000 B. C., King Solomon built aqueducts. We also read that the good King Hezekiah, 717 B. C., "made a pool and a conduit and brought water into the city." According to Dr. Bertholet of the University of Basle, this is now confirmed by an old manuscript of that period, recently discovered, which translated, reads: "Hezekiah fortified his city by bringing water thereto, and he bored through the solid rock by means of bronze, and he collected the water in a reservoir;" no mention is made of pipe. Within the past few years the tunnel has been identified, and pick marks indicate it was bored from both ends—



CROTON DAM NEARING COMPLETION, 1905.

an interesting bit of early engineering. Babylon (about 580 B. C.) had its great reservoir, canals and hanging gardens, but we find little to indicate how the water was distributed. Probably even earlier was built the great aqueduct at Carthage, some fifty miles in length. Its route may be partly traced to-day but the history of Carthage, like that of most cities of the time, lacks definiteness as to water supply distribution. Water brought by these conduits to these ancient cities must have been more or less distributed to public pools and fountains, and probably to important buildings, palaces and temples, and as the world progressed, clay and lead pipe were more freely availed of. Thus we read that about 600 B. C. the Greeks were building waterworks, using for distribution clay and lead pipe.

The Romans, too, had famous aqueducts; Rome some fourteen of them, aggregating about 359 miles in length, of which 304 were underground conduits, and 55 above ground. The Aqua Appia dates from the time of the Censor Appius Cœcus Claudius (312-304 B. C.) The others seem to have been constructed in the intervening period up to around the beginning of the Christian era. The two largest, Claudia and Anio Novus, 45 and 62 miles in length respectively, were built in 38 to 48 A. D. Their routes joined about six miles from Rome and thence there were two separate channels, one above the other, supported on arches, which at one point rise 100 feet in height.

LEAD PIPE. Of the Aqua Virgo it is recorded, "the water was conveyed in pipe, partly under and partly above ground, on a solid substructure or on arches." This reference to pipe is probably to lead pipe, which were evidently preferred for lines under more or less pressure, for lead pipe were used in "crossing valleys," "laid according to the slope of the hill," down to "a long level, then up," with intermediate standpipe or venters. According to Vitruvius (about 25 B. C.,) such lead pipe was made "in lengths of not less than 10 feet," and "take the names of their sizes from the quantity of the inches in the width of the sheets before they are bent around; thus, if the sheet be 50 inches wide before bending into a pipe, it is called a 50-inch pipe; and so of the rest." Vitruvius gives a list of ten sizes ranging from 100 inches, weighing 1,200 pounds, to 5 inches wide weighing 60 pounds per length. The pipe were probably soldered with an alloy of lead and tin. Lead pipe were also used for distribution, as to some extent were clay pipe "tongued at one end." The aqueducts supplied the baths and numerous large public fountains, from which last the people obtained their water, except such as could afford to pay for a separate pipe to their houses, and these latter were a source of considerable revenue. Vitruvius also notes injurious results from the use of lead pipe, adding "water should therefore on no account be conducted in lead pipe, if we are desirous that it should be wholesome." The excavations at Pompeii, which were destroyed by the great eruption of Vesuvius, 79 A. D. have revealed numerous fountains, and two thermæ or

GATE HOUSE AND RESERVOIR CONNECTIONS.

public baths which were supplied with water through lead pipe from reservoirs much as were the famous baths at Caracalla and other thermæ in Rome. Lead pipe as used by the Greeks and Romans were common enough in those days and probably for several centuries preceding the Christian era but we find no mention of iron pipe.

AQUEDUCTS. The term "aqueduct" was applied to the conduit as a whole, comparatively a small portion of which was carried on the arched masonry structures we are prone to think of as aqueducts, and it is interesting to note how at that early period these waterways were built so much of their length underground. Their grades (Vitruvius suggests "a fall of not less than one half a foot to a length of one hundred") were so adjusted that the water flowed by gravity without undue velocity, as much in vented tunnels or conduits as possible, and thus often wide detours were made. For instance, the Aqua Claudia starts at a point thirty-five miles from Rome, and winds its way, a distance of forty-five miles, to the city. The conduits were lined with some material impervious to water, and in section varied with

location. Tunnels were ventilated by vertical shafts, and usually the valleys were crossed with arched structures. To some extent the Romans may have copied the Greeks, who apparently did not use the arched masonry aqueduct, at least until much later, but carried their vented conduits through hills into valleys under streams and, to supply Syracuse, even under the sea. Considering the material available these underground conduits are remarkable, and as some must have been under considerable pressure it is probable early Greek engineers had "troubles of their own" causing the Romans to adopt the arched masonry aqueduct. On the other hand, possibly Greek engineers were not then well versed in arch building. Be this as it may, it is hard to realize that anything with which we are so familar as the arch, or water works, or even cast iron pipe, were at any time novelties and really had their day of invention and introduction. There is no telling what early Greek and Roman engineers would have done could they have had cast iron pipe as we have them. That in those far off days they were able to accomplish so much is surprising, and it must have cost much in labor and patience. Think of driving a tunnel through rock without the appliances we have available today; and yet the water supply of Athens was obtained through three underground conduits mainly cut through rock, two of them passing under the bed of the river Illissus. These brought water to a reservoir outside the city from which it was distributed in underground channels of various forms and partly through pipe of baked clay and through lead pipe. Thus Athens early enjoyed its baths, fountains and public water supply, but the quite wonderful aqueducts of the Romans, and those later built in France and other countries, are the most notable monuments to early water works engineers. One of the most beautiful later structures, dating from the seventh or eighth century, is the aqueduct Dalle Torre, near Spoleto, Italy, with its ten graceful pointed arches of 66 feet span, and nearly 300 feet in height, and which, restored, is in use today. Paris, London and Vienna, reaching back into the Roman period, and Berlin and other cities of more recent date, have each included in their development various water supply problems. Aqueducts, conduits, cisterns, reservoirs and fountains, with clay and lead pipe, (and later bored logs) seem to have been in general use and in the early days of Athens and of Rome we read of much that is interesting and curious, but we must pass over these intervening centuries to the time we first hear of cast iron pipe.

WACHUSETT RESERVOIR DAM, 217 FEET HIGH.

MASONRY AQUEDUCT ON LINE FROM WACHUSETT RESERVOIR.

CASTINGS OF IRON. Not until the fourteenth or the fifteenth and sixteenth centuries are castings of iron really mentioned. In the latter, cast iron cannon was made. Naturally not long afterward cast iron pipe were produced and we hear of it early in the seventeenth century. In 1720 it was said "there is not a street in London but water runs through it in pipe, conveyed underground," and while the kind of pipe is not specified, they were probably, in part, of cast iron, as such pipe had been used in France in the preceding century. Since 1700 we find their use constantly increasing and in the last century they played an important part in the makeup of most conduits and aqueducts, to say nothing of mains for distribution.

MODERN CONDUITS AND RESERVOIRS WITH CAST IRON PIPE.

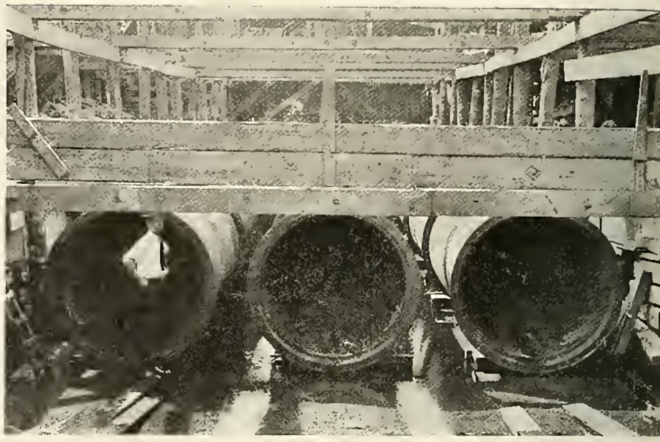
The canal, with its forty-five tunnels and numerous aqueducts, which brings water some sixty miles to supply Marseilles, and the Old Croton Aqueduct, with its conduits, tunnels and splendid stone arched bridge carrying cast iron pipe over the Harlem River, and which conveys water some thirty-four miles to New York, are examples of comparatively modern aqueducts, both having been completed about 1842. Since then the development of the Croton water supply has gone on apace, with its well-known reservoirs, conduits and piping; one set of the latter comprises eight lines of 48-inch cast iron bell and spigot pipe laid in one trench, which lead from the 135th Street Gate House. Here also terminates the new Croton Aqueduct, completed in 1890, which is nearly thirty-one miles long, almost entirely in deep rock tunnels, only a little over a mile being in trench or on embankment. The new Croton dam, now completed, is the highest and largest reservoir dam in the world, and contains 850,000 cubic yards of masonry. The new Croton reservoir is nearly twenty miles long, and there are nearly seventy-five miles of stone walls surrounding the land required for it. When full, the old Croton dam about three miles above will be submerged to a depth of 34 feet, and the reservoir will contain about 38 billion gallons. This, with the other reservoirs of the Croton watershed, will afford an available capacity of 72 billion gallons, which is barely sufficient for present needs. The proposed new supply for Greater New York, recently authorized, (1905) will be taken from Esopus Creek in Ulster County, New York, about ninety miles north of the city, requiring the crossing of the Hudson River by the proposed 500 million gallon tunnel and trench aqueduct. The works will include a 66 billion gallon reservoir with a masonry dam, 1,280 feet long and 175 feet high from creek bed, contract for which was recently let.

As we look over the more recent undertakings we find cast iron pipe becoming more and more of a factor, as used for gate houses, reservoir connections, for siphons in crossing valleys, and for supply mains. The new water supply at Manchester, England, for instance, comes largely from the beautiful Lake Thirlmere, a distance of some ninety-six miles, through a modern conduit partly in tunnels and cut and cover channels, while it dips into valleys and under streams by means of inverted siphons of several lines of 48-inch, 42-inch and 36-inch cast iron pipe some of them subject to a pressure due to more than 400 feet head. Another recent achievement in Scotland is the completion, in September, 1905, of the new water supply for Edinburgh. The water is brought some thirty-six miles from Talla in the parish of Tweedsmuir, Peebleshire. The conduit is composed of 23 miles of built tunnel, cut and cover aqueduct, with six siphons each of several lines of 36-inch to 27-inch cast iron pipe, in all 13 miles of line in piping, and the new plant includes a reservoir which when full will contain more than 2½ billion gallons.

Perhaps the most notable of recent water supply undertakings in the United States is that of the Metropolitan Water and Sewerage Board of Massachusetts, at Boston. This comprises the great Wachusett Reservoir, now finished, covering 7,200 acres, with a capacity of 63 billion gallons, with its massive dam 217 feet in height, containing 280,000 cubic yards of masonry and which, with the late Cochituate and eight reservoirs on the Sudbury River,

is calculated to be capable of supplying 173,000,000 gallons per day to the nineteen municipalities comprising the Metropolitan Water District. Water is conveyed from the reservoirs to this district, distances of from fifteen to thirty miles, through the Cochituate, Sudbury, Wachusett and Weston Aqueducts the two latter having each a daily capacity of 3 million gallons. These aqueducts are, in general, constructed of masonry covered by earth embankments, but there are 6.6 miles of tunnels, and in several instances the aqueducts cross valleys on masonry arches or by means of pipe

DOUBLE 60-INCH LINE TO RESERVOIR. METROPOLITAN WATER DISTRICT, SPOT POND.



LAYING THREE LINES OF 60-INCH PIPE UNDER CHARLES RIVER, BOSTON, USING COFFER DAM.

siphons.* Water delivered by the aqueducts is distributed to the several cities and towns comprising the Metropolitan Water District by means of 84 miles of cast iron pipe 34 miles of which are 48 inches and 60 inches in diameter.

Connected with the distribution system of the several municipalities, there are in addition 1,423 miles of cast iron pipe in sizes from 4 inches to 48 inches. Several of the pipe lines are carried

FOUR LINES OF 60-INCH CAST IRON PIPE. ONE 48-INCH AND ONE 30-INCH SHIFTED TO LEFT.

60-INCH ROSEMARY SIPHON WELLESLEY, MASS.

under navigable streams, requiring the use of pipe with flexible joints, the use of coffer dams, or other special methods of pipe laying.†

The present consumption of water in the district supplied, is about 117 million gallons per day, equivalent to 120 gallons per inhabitant. About 25 per cent. of this quantity is delivered by gravity, the remainder being pumped at pumping stations located at the Chestnut Hill Reservoir about five miles from the State House. These stations contain modern pumping engines of the highest efficiency, capable of pumping 171 million gallons of water per day.

Within the limits of the Metropolitan District, which in general includes the cities and towns within ten miles of the State House, there are several distributing reservoirs, the largest of which, Spot Pond, has a capacity of one billion eight hundred million gallons, and is 163 feet above Boston city base, which is substantially low water mark in Boston Harbor. The water supplied to each municipality is measured by means of Venturi meters placed on the connections between the Metropolitan pipe and the pipe of the several cities and towns, fifty-three meters being used for this purpose.

The board having charge of the Metropolitan Water Supply, also has charge of the Metropolitan Sewerage Works, and in connection with these works has recently completed the construction of new works for the disposal of a portion of the sewage of the district. In the portion of the system recently built, the sewage is discharged into the ocean through two lines of 60-inch cast iron pipe each extending about a mile from the shore.

* For this purpose cast iron bell and spigot pipe in sizes up to 84 inches inclusive may now be had.

† Some of these are referred to in late installments under "Submerged Piping."

At Philadelphia, the recently completed Torresdale conduit or tunnel which conveys water from the Torresdale filter beds to the Lardner's Point pumping station, is worthy of mention. Here again 60-inch cast iron bell and spigot pipe play an important part in forming the force mains from these pumping stations to Frankford Creek, where the water is delivered to the distribution system, working against a 48-inch relief line to Oak Lane Reservoir. In a recent report by a board of expert engineers, it is suggested that the use of 60-inch cast iron pipe instead of the masonry conduit from filters to pumping station would have been cheaper and preferable. Four lines of 60-inch cast iron pipe lead from the Lardner's Point pumping stations, and were put down after two lines of cast iron piping, 48-inch and 30-inch diameters, under water pressure, had been moved to one side. Some two blocks from the pumping station, three lines of the 60-inch cast iron force mains are led off toward Frankford Creek. The photograph shows a section of these 60-inch force mains as tested in the open trench, when they were subjected to a pressure of 200 pounds for five hours.

We have now had a hurried look at some of the waterways and works of earlier times and a closer view of some modern plants. Thus we see engineers using and depending more and more on cast iron pipe, and they are to-day a most important factor in the development of modern water supply. Cast iron pipe have completely changed earlier methods, and made possible the widely extended distribution of water, to say nothing of their use for gas and other well known purposes.

(To be continued.)

TIMBER OWNERS ORGANIZE TO FIGHT FIRE.

One of the most important economic movements of the day about which the general public has yet learned little is the concerted action of owners of timber in different parts of the country in organizing associations to protect their holdings from fire. In the Pacific Northwest, the Washington Forest Fire Association has just elected officers at Seattle and begun work for the year with 3,000,000 acres under its care. The plans include a system of patrol by rangers resembling the work done by the United States Forest Service in guarding against and extinguishing fires.

Organizations of similar kind and for a like purpose are at work in Oregon and Idaho. In the latter State, a portion of the expense is borne by taxation and paid from the State Treasury. A western railroad company which holds large tracts of timber has taken steps to guard its property from fire, and during the short time that its plans have been in operation, it has met with most encouraging success.

Similar work is being done on the other side of the continent. Forest owners in Maine have gone to work in the same systematic way to control the forests' great enemy, Fire. Like organizations are found in other parts of the country, showing how fully it is now realized that protection against fire is of the greatest importance.

It is safe to say that fires in this country have destroyed more timber than lumbermen have cut. When timber was abundant, the waste passed almost unnoticed, but now that a scarcity is at hand and an actual wood famine threatens in the near future, the owners of forest lands are waking up and taking action to save what is left.

CALCULATIONS FOR POWER PLANTS.*

By Dr. Franz H. Hirschland.

Every manufacturer of chemical, mechanical or any other goods has to make himself familiar with the kind of power and power generation which he wants to use in his factory. The success of an enterprise depends, to a great extent, on the price of power. The decision on the location of a plant is not merely influenced by railway connections, source of raw materials, points where to deliver the goods, labor questions, etc., but also to a great extent by the power question. Especially important, of course, is this question in electro-chemical enterprises where power is the greatest expense.

To solve the question which kind of power and which kind of power generation is the best and most advantageous one, in a general way, is an impossible task. The items, which have to be considered on answering such a question, change from case to case, and depend not only on the size of the power house, the number of hours which the machines have to run, but also on the voltage which may be required and many other points.

To give a scheme how the power generation question can be solved from case to case, one example is taken in the following and a comparison is set between.

1. Steam.
2. Gas.
3. Hydro-electric power.

It is presumed that a power house of 800 kilowatts, delivering 6,200,000 kilowatt-hours per year, is used for an electro-chemical process. The plant having to run about 24 hours per day makes it necessary to devote special consideration to the spare engines.

To give a comparison between the different kinds of power generation, the utility of a plant in a general way, the price of the plant and the price of the current at the switchboard have to be compared.

I. Steam Power.

In deciding on a steam-power plant, there is the choice of either steam engines or turbines. With regard to the expenses of the plant and economy of the same, both plants are about equally good, but it has to be considered that the high speed of the turbines combined with the low voltage of the dynamo machines required for electrolytical purposes makes the use of the turbine less advantageous.

Should steam also be required for heating and melting purposes, as it is often the case in electrolytical processes, this can be easier done from a steam engine than from a turbine. With steam engines it is possible to take steam either out of the receiver between high and low pressure cylinder, or to let one of the steam engines run without condenser, the same working with a certain counter pressure. With steam turbines, the same solution would materially affect the economy of the plant.

There being no great difference in price, space and equipment between steam engines and turbines of the required size, the choice remains more a matter of personal taste than of technical advantages.

A condensing plant can be considered in most cases to be economical, at least if a factory site can be located in such a way that there is a sufficient amount of cooling water.

The use of superheated steam for the steam engines would scarcely bring any advantages, as the valves of the Corliss engines, which are most extensively used in this country, would have a tendency to bind. With turbines, on the other hand, the use of superheated steam would have to be very seriously considered.

For both cases a steam pressure of 150 pounds and a vacuum of 26 inches would meet the local requirements.

*Electro-chemical and Metallurgical Industry.

Assuming the above-mentioned points, the price of an electrical power station of 800 kilowatts, driven by a steam plant, would be, approximately, as follows:

Factory site	$ ......
Building with stack	28,000
Steam generators	20,000
Foundation	2,000
D. C. dynamos with switchboard, complete	24,000
Steam boilers, including brickwork, complete	16,000
Condenser, complete	2,000
Pumps, feed-water heater	2,500
Piping, complete	6,000
Traveling, crane	6,000
Freight (?)	2,000
Erection of all machinery	6,000
Total cost of installation	$114,500

The consumption of steam for a plant would be about 14 pounds per 1 horsepower-hour, or about 25 pounds per kilowatt-hour at the switchboard, in which latter amount the consumption of the auxiliaries is included. With an evaporation of 8 pounds of steam with 1 pound of coal of 13,000 to 14,000 B. T. U., 1 kilowatt-hour can be generated with 3 pounds of coal.

The price of current at the switchboard is composed as follows:

1. Depreciation and interest—

According to local usage the depreciation and interest, including repairs and insurance, can be put at 14 per cent of the capital amount, which makes per year $16,000

2. The operating expenses are divided into—

A—Labor.

One would require, assuming two shifts, ten men earning per year about 7,400

B—Fuel.

For the generating of 6,200,000 kilowatt-hours, at 3 pounds of coal per kilowatt-hour, 9,300 net tons of coal will be required per year. The different kinds of coal, which can be used for steam boilers, vary greatly in price according to the distance from the mine. Near the mines themselves, this coal can be obtained for about $1.25 per ton. Using this lowest figure to calculate on, the coal price would bring up the expenses for this item per year to 11,600

C—Petty Expenses.

Lubricating oil being the principal factor, this expense can be put down at a yearly figure of about 4,000

Drawing all these different expenses together, one finds that with a price of $1.25 per ton for coal the expenses for the generating of 6,200,000 kilowatt-hours during the year are, approximately $39,000

The price for 1 kilowatt-year is therefore $55.20.

II. Gas Power.

The gas engine has in the last few years awakened great interest all over the world.

First-class machine factories have begun the building of these engines, and many special factories already exist which make nothing but producers.

A large field has also been opened for the combustion engine on account of the large available supplies of natural gas. The oil engine is also extensively used for certain purposes.

A—Producer Gas Plant.

Producer gas plants are made both for anthracite and bituminous coal. For soft coal the plants become more difficult to serve, and the cleaning of the same is awkward. The price for such a plant is also several thousand dollars higher than for the same with anthracite. The safety factor and economy are in both plants roughly the same. The choice of one or the other can only depend upon the price of coal. Where both sorts of coal are equal in price there could be no hesitation in choosing anthracite.

All firms guarantee 80 per cent efficiency for their producers; that means they can obtain from 1 pound of coal of 13,500 British Thermal Units an amount of gas with 10,500 British Thermal Units. The caloric value of producer gas ranges between 125 and 150 British Thermal Units per cubic foot.

The cost of an electrical power station of 800 kilowatts, with a producer plant using anthracite coal, would then be as follows:

Factory site	$ ......
Building	23,000
Gas engines	55,500
Foundation	7,500
D. C. dynamos with switchboard, complete	24,000
Gas producers	21,000
Foundation	6,000
Compressed air starting apparatus	2,000
Water pumps with electric motor	1,000
Piping, complete	4,500
Traveling crane	6,000
Freight (?)	2,000
Erection of all machinery	7,500
Total cost of installation	$160,000

The price of a similar plant for soft coal would be about $165,000, the higher price being explained by the more expensive producer.

The consumption of coal in a producer plant shows the same to be very economical. The gas engine generates with about 10,500 British Thermal Units—one braked horsepower-hour. With an efficiency of the producers of 80 per cent and coal of 13,500 British Thermal Units, one comes to the result that 1 pound of coal produces one braked horsepower-hour.

One pound per braked horsepower-hour is the claim which all gas-engine manufacturers bring against their competitors in the steam-engine branch, meaning thereby either a good, soft coal, the size of which is not especially important (as the same binds, anyhow), or an anthracite coal of at least No. 1 buckwheat size; that means a coal which is sieved through netting 9/16 inch diameter. One can safely reckon upon the consumption of 1.9 pounds per kilowatt-hour at the switchboard, including all losses and the auxiliaries.

The price of current at the switchboard would be as follows:

1. Depreciation and interest—

14 per cent of $160,000 . . . . . . $22,400

2. Operating expenses—

A—Labor.

Ten men 7,400

B—Fuel.

1.9 pounds per kilowatt-hour, therefore, for 6,200,000 kilowatt-hours, 5,900 tons, at the price of $1.25 7,400

C—Petty Expenses.

(More and better quality of lubricating oil used than with steam engine) 5,000

With coal at $1.25 per ton, the entire expenses for generating 6,200,000 kilowatt-hours per year come to . . $42,200

The price of 1 kilowatt-year is therefore $59.60.

The depreciation and interest on gas engines being higher than on steam engines, the consumption of fuel on the other hand, higher with steam engines, gives one a certain coal price at which the generating expenses of both plants are equal.

In the above-mentioned cases this would be at a coal price of $2.18 per ton. If the price of coal is cheaper than this figure the steam engine plant is more economical; with higher prices of coal the gas engine plant is cheaper.

When having to pay a price of $3.00 per ton for coal, as, for instance, in New York and Jersey City, the price of current for gas engine plant would be about $67.20 **per kilowatt year,** and for steam engine about $73.00 **per kilowatt-year.**

In regard to safety and simplicity of regulation, both plants would be about equally good. The fact that one can over-load a steam engine very much more than a gas engine, is not so important in an electrolytic plant on account of the current consumption being particularly constant.

B—Natural Gas Plant.

Natural gas, which is especially well suited for gas engines, is to be had in the States of Pennsylvania and West Virginia. It has a very high caloric value, which can be placed at about 1,000 British Thermal Units per cubic foot.

The **price of such a plant** would be, approximately, as follows:

Factory site	$......
Building	9,000
Gas Engines	52,000
Foundation	7,000
D. C. dynamos with switchboard, complete	24,000
Compressed air starting apparatus	2,000
Water pump with electric motor	1,000
Piping, complete	6,000
Traveling crane	6,000
Freight (?)	1,500
Erection of all machinery	7,000
Total cost of installation	$115,500

The consumption of natural gas in a gas engine which can generate 1 horse-power-hour out of 10,500 British Thermal Units would be 10.5 cubic feet per braked horse-power-hour, calculating upon 1,000 British Thermal Units per cubic foot. With all losses and reckoning the auxiliaries, the consumption would then be about 18 cubic feet per kilowatt-hour at the switchboard.

The **price of the current at the switchboard** would then be as follows:

1. Depreciation and interest—
14 per cent at $115,500....$16,200

2. Operating expenses—

A—Labor.

Six men.... 4,700

B—Fuel.

The consumption for 6,200,000 kilowatt-hours at 18 cubic feet per kilowatt-hour is equal to 112,000,000 cubic feet per year. The price varies in the different cities from 4 cents to 20 cents per 1,000 cubic feet. Assuming a price of 4 cents per 1,000 cubic feet, the expense for fuel would be per year.... 4,480

C—Petty Expenses.

(Lubricating oil, etc.).... 5,000

Total expense, therefore, for the generating of 6,200,000 kilowatt-hours per year with natural gas, at a price of 4 cents per 1,000 cubic feet, would then be....$30,380

The price of 1 kilowatt-year is $42.90.

This price is comparatively low. The engine can also be considered as perfectly reliable. The only question is whether the flow of gas can be entirely relied upon or not. The difficulties which arise therefrom can be partially overcome by placing the plant as near to the natural gas well as possible, as the flow of gas is mostly disturbed through breakage and repairing of the gas pipes. In many parts of West Virginia the gas wells are considered to be inexhaustible, and especially so in Clarksburg and Fairmont, where gas at a price of 4 cents per 1,000 cubic feet can be obtained, and which cities are situated in the midst of great bituminous coal mines. At all events, it is advisable to consider the possibility of a failure, or at least a reduction of the pressure in the supply of natural gas, and it should be stated at this point that the alteration of a plant for natural gas into a producer plant is, under all circumstances, feasible.

Producer gas having a much smaller caloric value than natural gas, will make it necessary, in converting one plant into the other, to make certain alterations in the engines. The simplest method would be to alter either the mixing valves for gas and air or the compression. In this case the output of the machines would be reduced by about 20 per cent on account of the low caloric value of the gases. The dynamo machines would also be not used to their full load, and one would therefore require a new unit in order to attain the same current as formerly.

For this reason many firms recommend the use of new cylinders, retaining the frame, fly-wheel and all other parts, though some manufacturers think that the same effect could be reached by reboring the cylinder to 1 inch more in diameter and using new pistons.

C—Oil Plant.

For small plants, or in places where there is little room available, the oil engines can be used with advantage, especially as one saves the space necessary for a producer or boiler. Up to now, engines have not been built for more than a 150-kilowatt, so that for this special case one would require 7 units, counting in two spare engines.

The **price of such a plant** would be approximately as follows:

Factory site	$.......
Building	14,000
Seven oil engines	104,300
Foundation	8,000
Seven D. C. dynamos with switchboard, complete	28,350
Compressed air starting apparatus	2,000
Water pumps with electric motor	1,000
Piping, complete	5,350
Traveling crane	6,000
Freight (?)	2,000
Erection of all machinery	10,000
Total cost of installation	$181,000

The oil consumption would be 1 pound per braked horse-power-hour, which comes to about 1.6 pounds per kilowatt-hour at the switchboard, all losses and auxiliary machinery included.

The **price of the current at the switchboard** would then be as follows:

1. Depreciation and interest—
14 per cent of $181,000....$25,300

2. Operating expenses—

A—Labor.

Six men.... 4,700

B—Fuel.

The consumption of 1.6 pounds, or 0.21 gallon per kilowatt-hour would be for 6,200,000 kilowatt hours per year, 1,300,000 gallons, costing with the price of oil at 2 cents per gallon.... 26,000

C—Petty Expenses.

(Lubricating oil).... 5,000

The total expenses for 6,200,000 kilowatt-hours per year with an oil-engine plant would be, with oil at 2 cents per gallon, about $61,000

TABLE SHOWING COMPARATIVE RESULTS.

	Steam	Producer Gas.	Natural Gas.	Oil.	Hydro-Electric
Total cost of installation	$114,500	$160,000	$115,500	$181,000	$40,800
OUTPUT IN KW-HOURS PER YEAR 6,200,000					
Fuel or energy required for 1 kw-hour at switchboard	3 lbs. of coal.	1.9 lbs. of coal.	18 cu. ft. of gas.	0.21 gal. of oil.	1.54 hp-hour
Lowest obtainable price of fuel or energy	$1.25 per ton.	$1.25 per ton.	$0.04 per 1000 cu. ft.	$0.02 per gal.	$16 per 1 hp-year.
Fuel cost or energy cost per year	11,600	7,400	4,480	26,000	17,600
Labor per year	7,400	7,400	4,700	4,700	1,600
Petty expenses per year	4,000	5,000	5,000	5,000	1,000
Depreciation and interest per year	16,000	22,400	16,200	25,300	5,700
Total cost of current at switchboard (6,200,000 kw-hours)	39,000	42,200	30,380	61,000	25,900
Cost of current per kw-year	55.20	59.60	42.90	86.00	36.60
Comparative cost of current with electricity at 100	151	163	117	235	100

The price per 1 kilowatt-year would therefore be $86.00.

This price per kilowatt-year, calculating upon an oil price near the points of production, is so high that the use of the oil engine cannot be considered in this problem, especially as the price of the oil in the East is double that quoted.

III. Hydroelectric Power.

Though the direct use of turbines and water power is uneconomical in very small plants, the same becomes a most important factor if it is worked on a large scale, as, for instance, at Niagara Falls. In the big turbine plants very high voltage alternating current is generated, which is especially adaptable to the transmission of energy.

For our purpose it would therefore be necessary to transform the alternating current into a direct current of 150 to 200 volts. A rotary converter would be the simplest method of solving this problem, but in consideration of the great difference in voltage on both sides of the machine it will be better in this case to use a motor generator. This plant shall consist of 2 units, as a spare unit may not be needed in such a simple plant.

The approximate price of such a plant would then be as follows:

Factory site	$......
Building	7,000
Motor generators with switchboard, complete	30,000
Foundation	1,400
Freight (?)	400
Erection of all machinery	2,000
Total cost of installation	$40,800

The efficiency of the plant could be taken at about 0.87. The price of the current at the switchboard would then be as follows:

1. Depreciation and interest—

14 per cent of $40,800 .... $ 5,700

2. Operating expenses—

A—Labor.

Two men 1,600

B—Current Consumption.

The lowest price of 1 horse-power-year, which may be offered at the present time, is $16.00; 6,200,000 kilowatts per year, or 1,100 horse-power-year, will represent 17,600

C—Petty Expenses.

(Lubricating oil, etc.) 1,000

Total expense, therefore, for a plant of 6,200,000 kilowatt-hours per year, at a price of $16.00 per horse-power-year, would then be $25,900

The price for 1 kilowatt-year would, therefore, be $36.00.

SPLICING LEAD-ARMORED CABLES.*

H. H. Brown

There is no link in an electric system more reliable then lead-armored underground cables, yet more unreliable if improperly installed. Hundreds of miles of cable are operating at voltages up to 15,000, and actually show better results, as regards continuity of service, than the best aerial construction.

The weakest point in all cable lines are splices, and it is here that breakdowns usually occur. For this reason cable-splicing requires the exercise of the utmost skill, and it is a trade within itself. No description can supply this skill and experience, but the writer believes that a brief description of the methods followed by the San Francisco Gas and Electric Company, which he believes represents the best practice, will be both interesting and instructive.

In the following description, multiple conductor, or "multiplex" cables, to operate at 6,600 volts or over, will be assumed. The same general method and precautions apply to single conductor, or "simplex" cables, and cables to operate at lower voltages.

A splicing crew consists of a splicer and one helper. The splicer must be a skillful workman, who has learned his trade thoroughly by serving an apprenticeship as helper. The crew is supplied with the following tools:

Wheelbarrow.	Chipping knife.
Tool box.	Insulating knife.
Plumber's furnace.	Large ladle.
Large melting pot.	Small ladle.
Small melting pot.	Soldering iron.
Large coffee pot for boiling "ozite."	Hack saw.
	Monkey wrench.
Small coffee pot.	Stilsen wrench.
Catch pan.	Screwdriver.
Two small funnels.	Plyers.
Lead dresser.	Dog tent (during rainy weather.)
Scoring tool.	
Gorge tool.	

In addition, the following materials are supplied:

Wiping lead.	Paper tape.
Stick solder.	Pure rubber tape.
"Ozite" insulating compound.	Soldering flux.
	Copper connections.
Tallow candles.	Waste.
Pasters.	

Cables are commonly left by the "pulling gangs" with two or three feet of extra length in each manhole. This is to allow for proper placing upon supports around the side of the hole, and the further reason that the first one or two feet of the cable, particularly after a hard pull, is liable to be crushed by the pulling clutch, and therefore unreliable and must be discarded.

*California Journal of Technology.

Upon entering the manhole, the splicer first places protectors of lead around the cable at the point where it enters each duct line. The protectors are commonly made of old pieces of lead armor, beaten into shape. As a further temporary protection, the mouth of the duct should be thoroughly packed with waste, particularly under the cable. Next to the joints, the most prolific source of trouble in cable lines are the points of entrance to the manholes, as it is here that short bends or buckles are liable to occur. Short bends are to be avoided *absolutely*.

The splicer next examines the cable carefully for signs of mechanical injury, that he may plan his splice to cover such injured point, if there be any. The position of the splice is then carefully determined so as to rest finally between two supports upon the side of the manhole, where it will be subjected to no mechanical strain. Joints must be carefully supported on each side, and no portion of the weight of the cable, or bending strain, be allowed to come upon them. In the following description we will assume that the cable has been found free from injury and that we can place our supports at will. These supports commonly consist of pieces of ½-inch gas pipe cemented into the manhole sides, and spaced about two feet apart.

The injured ends of the cable are then cut off, care being exercised to cut as little as possible, and the cables tested for moisture. Slight imperfections in the sealed ends often admit moisture to the interior, particularly if the weather be rainy or the manhole damp. This is best accomplished by dipping the exposed end of the cable into a ladle of hot "ozite." If it "spits," there is moisture present, which will be further indicated by the formation of a brown froth. The writer has found this method to be always reliable. Care must be exercised not to have the ozite compound too hot, as will be described later. If moisture be present in one and not the other, the one showing moisture should be cut back a little at a time, until it becomes dry. If moisture is present in both, the splice should be located at the most convenient point, and resort be had to drying. To dry the cable, a torch is played upon the lead armor, beginning at the duct and slowly approaching the end, the torch being turned about the cable. The armor must not be allowed to heat sufficiently to soften.

After the cables "show dry," they are cut off the proper length. For single-conductor cables, a lap of about one inch or less is proper. For multiple-conductor, or "multiplex" cables, a considerable lap must be left to allow for staggering the conductor splices. About six inches from the central point of the splice, the lead armor is then scored circumferentially, care being exercised not to cut completely through. Some splicers perform this with a hammer and chipping knife, a practice to be strongly condemned, as the knife is liable to enter the interior insulator. The lead is then cut longitudinally by means of a hammer and chipping knife, the knife being so held as to enter the cable tangential to the interior insulation. The knife should be forced by slight taps of the hammer, heavy blows being avoided. The lead cover is then removed by bending outward with the plyers, beginning at the cable-end, and finishing by breaking at the circumferential cut. The end of the lead remaining on the cable is then belied out by means of a wooden stick or other blunt instrument, and the end carefully dressed smooth with a file. This leaves a final length of the completed splice of about twelve inches. For very heavy multiplex cables, this may be extended to eighteen inches.

In multiplex cables, the conductors are each separately insulated and the interior of the cable filled with some insulating filler. This filler is now cut through and removed to within about two or three inches of the end of the lead. During this operation extreme care must be exercised to prevent the knife from touching the insulation of the individual conductors. The exposed conductors are then laid together and the splices so planned that they will stagger.

While the splicer is engaged in the foregoing work, the helper, who is stationed at the top of the manhole, is heating the solder and ozite, and preparing the lead sleeve for covering the splice. These lead sleeves vary in size from 1 to 5 inches interior diameter, and from 6 to 24 inches in length. The sleeve is prepared by beating the ends down to a size just larger than the outside of the cable. This can be done by using a rawhide mallet or block of hard wood. Metallic hammers should never be used. The reduced ends are then scraped thoroughly, to a point well on the sleeve, and smeared with candle tallow, to prevent the formation of lead oxide. Two half-inch holes are drilled in the sleeve, one near each end, all edges carefully smoothed, and the sleeve is ready to be placed.

The splicer slips the lead sleeve over one cable and pushes it back out of the way, and the conductors are sleeved together and soldered. These copper sleeves should have a sectional area equal to the sectional area of the conductor, and the conductors should be carefully butted within the sleeve. After soldering, all points should be removed with a file. Neglect of this may cause a breakdown in high-tension cables, as it leaves discharge points for the escape of the current. The insulation of the conductor, if larger than the sleeve, is tapered down, and the joint carefully insulated with *pure rubber* tape. "Okonite" tape is not used for this purpose. The joints are then thoroughly dried out by pouring hot ozite over them, the ozite falling into a catch pan below the cable. The ozite should be hot enough to spit when moisture is introduced, but not hot enough to ignite a piece of paper. If too hot it may set fire to the cable and destroy the joint. This has frequently happened, and it is a point to be observed. Another precaution is in making the splice and in taping, so as not to bend the conductors sharply back out of the way, as it may result in injury to the cable at the points where the conductors enter the cable-filler. If necessary to bend the conductor, it should be a long radius bend, made by holding the conductor where it enters the filler.

Certain manufacturers recommend the use of cotton tape, covered by a specially perforated paper or rubber bushing, in place of pure rubber tape, as an insulator for the conductor of joints. In some respects this method seems preferable, as it allows the hot ozite compound to flow directly to the joints, and insures proper spacing of the conductors. The writer is unacquainted with the practical application of this method.

After the conductors are given ample spacing, by bending slightly outward, the lead sleeve is slipped over the splice, the lead armor of the cable scraped clean and the sleeve wiped in place. It requires from 1 to 8 pounds of wiping lead for each splice, depending on the size of the cable. Hot ozite is then poured into one of the holes previously bored in the lead sleeve until it flows freely from the other. If moisture be present it will be indicated by a brown froth. The ozite should be allowed to flow until all this froth disappears. After about an hour's cooling the ozite will have shrunk, which necessitates the introduction of an additional amount. The previously mentioned precaution as to temperature of ozite should be always observed. The holes in the lead sleeve are soldered over, the cable carefully placed upon its supports and the splice is completed.

Important high-tension splices should not be made during rainstorms, and in no case should such a splice be left over night without being completed and sealed up. In going to and from manholes, cables should not be used as foot-rests. Steps should be provided.

NOTICE OF ERRATA.

In the article on "Relative Value of Coal and Oil as Used for Fuel," by R. F. Chevalier, page 286, May 2, 1908, "boiler" should be substituted for "brake" in the first and second lines of the second paragraph.

In the seventeenth line of the second column of the editorial on "Steam From Fuel Oil," "per barrel" instead of "per ton."

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MAY 16, 1908 No. 20

EDITORIAL.

CONTROL OF PUBLIC UTILITIES.

Centralization of natural forces is necessary if they are to be used by a public whose civilization depends upon the minimizing of length, mass and time, and the voluntary regulation of the relative intensity of heat and light. This has been done by steam and electric transportation, gas and electric lighting, water-power utilization, and its transmission and distribution by electricity, which at present are largely under the organized direction of individuals. As a substitute for certain abuses of this private control, public ownership has proved partially successful but not wholly satisfactory. Hence, the alternative of public control of private ownership, which it is hoped will combine the advantages and eliminate the errors of both systems. Experience has shown that the best talent is attracted and works in a more efficient manner under private direction. Because of various motives, socialists and sentimentalists under the shrewd tutelage of astute politicians have been arrayed to destroy the big things builded by busy men with brave money. In the shadow of the mighty edifices reared by corporate power great evils undoubtedly do exist, but how much better is it to remove these worms that can live only in the dark, by means of the light of publicity, than to tear down meritorious institutions in whose shadow they crawl! Such light is far more effective than is heated argument, whose chief effect is to destroy confidence, the basis of all business.

But even this destructive force might be utilized if it possesses sufficient constructive power. The substitute proposed is excellent in theory, but so long as politicians see only additional patronage in municipal ownership, so long will its duties be performed by inferior men. Consequently, recognizing the limitations of human integrity and profiting by the experience of others, Massachusetts, New York and Wisconsin have provided public commissions to supervise private ownership.

The idea of a Public Service Commission is essentially that involved in many of the so-called bank and railroad commissions, but fraught with greater power for either good or evil, according to its personnel. For of greater importance than the laws defining its power are the men that compose it. They should be tried, technically trained men, who not only are faithful to the trust imposed in them by the public, but who realize the effect of their decisions on the practical operation of power, lighting and communication interests. Satisfaction can only be insured by fixed tenure of office, free from political direction and uninfluenced by local sentiment. There is not much difference between the fear inspired by a corrupt body and the dread caused by a well-meaning but an incompetent and inexperienced commission.

In its delicate function as the rider on the balance that weighs the relative value of the prices charged and the returns from capital invested, it should be borne in mind that its power is for regulation not operation. This policy which promises to replace the inadequate one of regulation by competition, will be operative only if it can provide proper protection for capital invested. The quasi-public corporations, in return for franchises and privileges granted, furnish the public a service which it needs, and they expect an ample return upon the investment commensurate with the risks assumed. If such is not provided, it amounts to confiscation. As the basis for figuring capital invested should be included not only the tangible property, but also the expenditure legitimately involved in perfecting the organization. This includes lawyers' expenses, the cost of bringing employees to the proper standard of efficiency, interest on the investment until the property is self-supporting, taxes and machinery repairs.

Its relation to the public it serves is simple but not less important than its stand toward the public-service corporation. Most people want good service, whether from hotel, railway, lighting, telephone or power companies, and do not much care as to the means by which it is accomplished. It should be the endeavor of any commission to force corporations to give the best service at the least cost allowable for fair profit over and above the operating expenses.

PERSONAL.

T. E. Bibbins left for the East on May 15th, to be gone for five weeks.

The Invincible Renovator Sales Company of California has offices at 950-954 Monadnock Building, San Francisco.

F. F. Barbour has been appointed assistant to the president of the Portland Railway Light and Power Co., at Portland, Oregon.

O. N. Lacey, secretary of the Hanford Mill & Electric Light Works, Hanford, Cal., was in San Francisco recently.

Frank S. Trumbull, of the Trumbull Electric Manufacturing Company, has been in San Francisco recently on business.

Elisha B. Seeley, general manager of the Couch & Seeley Co. of Boston, Mass., has been in San Francisco during the past week.

John F. Willard has been made manager of the Union Gas Engine Co., with offices and salesrooms at 503-505 Mission St., San Francisco.

M. J. Corwin, formerly engineer of the Farmers' Mutual Telephone Company, of Everett, Wash., has been appointed representative of the Dean Electric Company, of Elyria, Ohio, in the States of Oregon and Washington.

George Campbell, general manager of the Reno Power, Light & Water Company and the Reno Traction Company, has been in San Francisco to consult the directors with regard to the extension of the street car line in Reno.

TRADE CATALOGUES.

"Magic Methods" from H. W. Johns-Manville Co, 100 William St., New York City, tells how Magic Boiler Compound eliminates boiler troubles, such as scale, pitting, corrosion and leaking. It "acts on the iron—not on the water."

MEETING NOTICE.

The Technical Publicity Association at its annual meeting, April 30, 1908, elected the following officers to serve during the ensuing year: President, C. S. Redfield, advertising manager Yale & Towne Manufacturing Company, New York; first vice-president, Rodman Gilder, publicity manager Crocker-Wheeler Co., Ampere, N. J.; second vice-president, C. N. Manfred, manager advertising department H. W. Johns-Manville Co., N. Y.; secretary, H. H. Kress, publicity department A. S. Cameron Steam Pump Works, New York; treasurer, H. M. Davis, advertising manager Sprague Electric Company, New York; members of executive committee: F. H. Gale, charge of advertising of General Electric Company, Schenectady, N. Y., and C. W. Beaver, special representative Yale & Towne Manufacturing Company, New York. Twenty new members have joined the association since the last annual meeting.

WARNING.

A man giving his name as George Williams, and stating that he is connected with the Brenham-Compress Oil & Manufacturing Company, Brenham, Texas, has approached several electrical companies, including some dealers in Buffalo, with the evident intention of defrauding them. One of his methods has been to place a substantial order for electrical material, with which he seems to be thoroughly familiar, and after offering checks and referring to his credit with Texas banks, he attempts to borrow money. Subsequently it has turned out that his checks offered in payment are not covered by the local banks in which he claimed he had deposited, or would deposit, money to cover his purchases. The man did not deposit the funds as promised, and used the receipt for the checks in an attempt to secure more material from another dealer. This man is described as about five feet nine, stocky build, weighing about 170 pounds; has light hair, blue eyes, smooth face; large, rough, weather-beaten features; upper front tooth broken or missing; wore a soft hat and dressed in general Western style.

GENERAL ELECTRIC ANNUAL REPORT.

The sixteenth annual report to the stockholders of the General Electric Company, covering the year ending January 31st, 1908, shows that the profits, after deducting all patent, general and miscellaneous expenses, and allowances for depreciation and losses, and writing off $3,745,989.06 from factory plants, were $6,586,653.37; paid in dividends during the year, $5,183,614; carried to surplus account, $1,403,039.37; surplus at the end of last fiscal year, $15,110,796.77; total surplus January 31st, 1908, $16,513,836.14.

Late in the year there was a sudden and severe shrinkage in the value of all merchandise and materials used by the company, notably copper. All said materials, whether raw, manufactured, or in process of manufacture, which were on hand January 31st, 1908, were inventoried at the lower prices then prevailing. The book value of such inventories was thereby reduced by about $2,000,000.

In valuing the notes and accounts receivable, in amount the largest in the company's history, great care has been exercised and liberal reserves have been established to provide for possible losses thereon. These reserves and allowances for depreciation of factory plants and the shrinkage in inventory values have greatly reduced the profits. As a result, the amount in excess of dividends upon its share capital, which is carried forward to surplus account is relatively small. During the year all the assets and liabilities of the Stanley G. I. Electric Manufacturing Company, Pittsfield, Massachusetts, were taken over, and the factories owned by that company at Pittsfield are now a part of the factory plants of the General Electric Company. In this practical liquidation of the Stanley Company there has been a considerable shrinkage in the valuation of its factory properties, inventories, and other assets, thus adding to the otherwise large depletion in the profits for the year.

The unencumbered fee of about 700 acres of land adjacent to the city of Erie, Pa., was purchased at a cost, including engineering and other expenses, of $232,301.53. In view of the existing depression, the erection of buildings thereon is deferred for the present. The various securities included in the stocks and bonds account have been carefully re-valued, item by item, with the result that the book value thereof has been fixed at $18,000,089.85.

The report upon sales presented by Vice-President J. J. Lovejoy shows total sales billed of $70,977,168, and total orders received of $59,301,040.

In the ten-year period ending January 31, 1908, sales billed have increased from $12,396,093 to $70,977,168, an average increase of 19.8% per year. Sales billed during the year 1907 increased 18.2 per cent over the previous year. Orders received during the first six months of the fiscal year, February 1 to July 31, 1907, increased 22 per cent over the corresponding period of the year 1906. Owing, however, to the disturbed financial conditions prevailing during the latter part of the year, orders received for the second six months of the fiscal year decreased 23 per cent as compared with the previous year. Since November last there has been a heavy decrease of orders received as compared with the past three years. The total number of separate orders and contracts received during the year was 237,006, an average per week of 4,558.

Among many important orders received during the year are:

Great Western Power Company, San Francisco, Cal., three water wheel generators, 10,000 kilowatts each, together with the necessary transformers and other electrical apparatus for transmitting current at 100,000 volts from its power house on the Feather River to Oakland, Cal., a distance of about 165 miles.

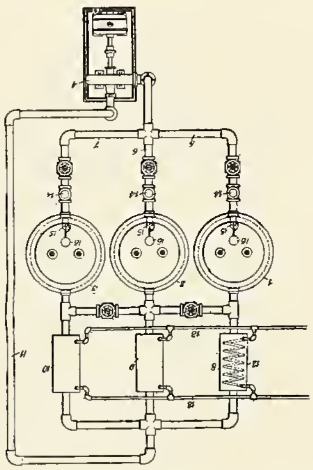
The Central Colorado Power Company, Colorado Springs, Colo., four 5,000-kilowatt generators and other electrical apparatus for water-power development at Glenwood Springs,

(Continued on page 311.)

PATENTS

COOLING SYSTEM FOR ELECTRIC APPARATUS. 886,073. Karl C. Randall, Edgewood Park, and Charles B. Gibson, Wilkinsburg, Pa., assignors to Westinghouse Electric & Manufacturing Company.

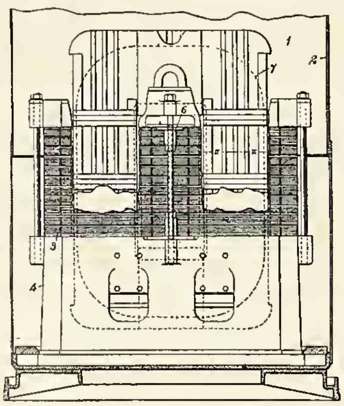
The combination with a plurality of electric transformers,



fluid-containing tubes therefor, cooling chambers and means for maintaining a circulation of insulating fluid through the tanks and the chambers, a throttle valve in the supply line of each tank and means for automically controlling the throttle valve.

TRANSFORMER COIL INSULATION. 885,771. Jesse E. Mateer, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.

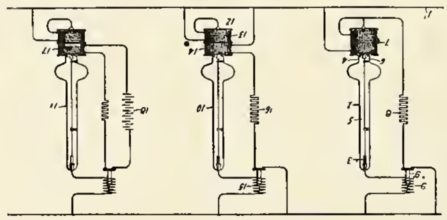
A transformer coil having spaced insulating strips at its



sides, insulating channel pieces fitted over its edges, angle pieces fitted over the channel pieces, and barrier plates extending along the sides of the coil in contact with said strips and angle pieces to form an inclosing casing.

STARTING DEVICE FOR MERCURY-LAMPS. 885,882. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company.

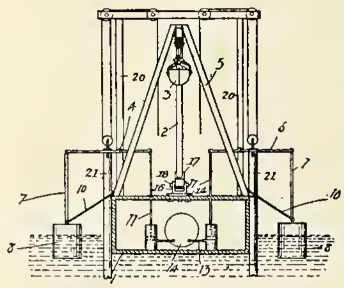
In an electrical system, the combination of a vapor electric device having an initially conductive path of high resistance



therein, means for supplying current therethrough, a movable member to start an arc in said device, electro-magnetic means traversed by said current and disposed for operating said movable member, and means for abnormally increasing the effectiveness of said electro-magnetic means at starting.

MEANS FOR UTILIZING WASTE POWER IN DREDGES. 885,900. Robert M. Wilson, San Francisco, Cal.

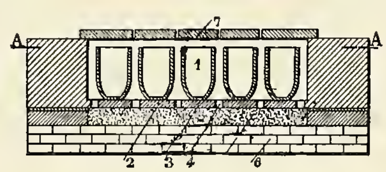
In an apparatus of the character described, the combination with the hull of a dredger, and a boom thereon adapted to swing



to a side of the dredger, and means for carrying a load at the end of said boom, a device supported at the side of the dredger independently thereof, and means carried by the dredger and movable therewith as it rocks transversely with the swinging movement of the boom, said means co-acting with said device to generate power.

ELECTRIC FURNACE. 885,745. Paul Girod, Ugine, France.

In an electric furnace, the combination, with a receptacle forming a chamber arranged to receive a plurality of objects to be heated and provided with end extensions, of insulating



masonry inclosing said receptacle and arranged to support said extensions, a mass of resistance material between the receptacle and the masonry pole pieces extending through the masonry and arranged to conduct current to the resistance material.

INDUSTRIAL

ATTRACTIVE NEW HOLOPHANES.

The demand upon the part of illuminating engineers, and others having to plan or specify lighting installations, for reflectors of more attractive designs than those ordinarily procurable, yet of such efficiency as shall commend them, has

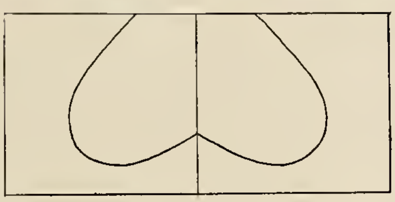
No. 7629

No. 4526

No. 4576

No. 4676

No. 4516



CHARACTERISTIC CURVE OF HOLOPHANE FRENCH SHAPED REFLECTORS.

led the Holophane Company to design and offer a new series of reflectors similar to their popular No. 4526. These reflectors, here illustrated, are numbers 2679, 45186, 4526, 4576, and 4676.

This design is very distinctive, being based upon the French shape originally brought out abroad. The ready sale of this series of reflectors in European markets, and the wide variety of applications to which they may be put, make them a welcome addition to the Holophane line.

The characteristic distribution of light obtained from the use of these reflectors is shown herewith. While the several designs vary somewhat in results given, this curve will serve as a general guide to the series. These reflectors are particularly recommended for use in connection with the smaller frosted tip tungsten lamps, as they completely protect the eye from the intense rays of the light.

GENERAL ELECTRIC ANNUAL REPORT.

(Continued from page 309.)

on the Grand River, the electrical energy to be transmitted throughout the central portion of the State for mining, general power, lighting, and railway service.

The Detroit River Tunnel Company, a subsidiary of the Michigan Central Railway Company, apparatus for equipment of the Detroit Tunnel under the St. Clair River. The contract includes several 1,000-kilowatt motor-generator sets, with accessories, and six 100-ton locomotives, each equipped with four 250-horsepower motors.

The Great Northern Railway, for electrification of the Cascade Tunnel, water-wheel generators and 100-ton locomotives, each equipped with four 250-horsepower alternating-current motors, giving a continuous output of 1,000 horsepower per locomotive.

The Southern Pacific Railroad, for electrification of its suburban lines in Oakland and Alameda, Cal., forty-four four-motor equipments with Sprague-General Electric control. The motors are 125 horsepower each.

The Hudson Tunnels Company, the turbine-generators, rotary converters, motors, and controlling apparatus for complete electrical equipment of its system of tunnels under the Hudson River connecting New Jersey and Manhattan. A portion of this system was put into successful operation on February 25th, 1908, and regular service is now maintained between Nineteenth Street (Sixth Avenue), New York City, and Hoboken, N. J.

The West Jersey & Sea Shore R. R. Co., a branch line of the Pennsylvania Railway running from Camden to Atlantic City, mentioned in last year's report, has maintained its record of satisfactory operation, and orders for additional equipment have been received during the past year to provide for the increased traffic.

The New York Central and Hudson R. R. Co. is now operating in its New York City Terminal thirty-five electric locomotives of their manufacture, each equipped with four 550 horse-power direct current motors. Twelve additional locomotives have recently been ordered, making a total of forty-seven locomotives purchased from them by this company.

The use of electrical apparatus for industrial purposes is extending rapidly, and large purchases of their apparatus have been made during the year for completely equipping mills with turbine and engine driven generators for lighting and power, and with motors of standard and special design for driving machinery of every description.

Orders for supplies, such as meters, transformers, arc lamps, winding devices, electric heating devices, repair parts of electrical apparatus, etc., show an increase over last year. The list of supplies comprises upwards of 50,000 items, separately catalogued and priced. In addition to the large stock of finished product carried at the several points of manufacture, they maintain fourteen warehouses in various cities, from which shipments to the value of over $6,000,000 were made during the year.

To meet the requirements of interurban railways where a potential higher than 600 volts is desirable and the conditions are unfavorable to the adoption of the single phase alternating current system, they have developed a high voltage direct current railway system to operate at 1200 volts. Two roads have been operating under this system for several months with entire success. Equipment for several additional roads of this character is in process of installation.

The Curtis steam turbine continues to give excellent service, and the confidence of users is evidenced by numerous additional orders for existing installations. The total number of Curtis turbines shipped to date is 960, having a total capacity of 1,086,000 horse-power. Orders were received during the year for turbines aggregating 380,000 horsepower. They now have in process of manufacture for the Commonwealth Edison Company of Chicago, and the New York Edison Company, a large number of turbine-generators of 14,000 kilowatt capacity each, which will be the largest steam driven electrical units ever produced.

The consumption of carbon filament lamps has steadily increased during the year, and with their enlarged capacity they are prepared to take care of the demand. In addition they have received large orders for different types of high efficiency metal filament lamps, first consideration being given to such sizes and types as will aid central lighting stations in providing for the requirements of their customers and the extension of their business.

The report of Vice-President E. W. Rice, Jr., upon Manufacturing and Engineering, shows that expenditures aggregating $6,350,576.74 have been made during the year for real estate, erection of new factory buildings, extensions to existing buildings, additional machinery, patterns, special tools, fixtures, etc. The increase in expenditures mentioned above over previous years is due to including the expenditures made during the year upon the Pittsfield plant, and to the urgent demand for largely increased manufacturing facilities to properly care for their business, which rose from $40,000,000 for the year ending January 31, 1904, to $60,000,000 for the year ending January 31, 1907, and culminated in an annual rate of $75,000,000 during the first quarter of the fiscal year just ended. The unfilled orders as of January 31, 1907, had also reached $28,000,000, and deliveries were generally unsatisfactory. Since the beginning of the business depression, expenditures for plants have been limited to those needed to complete extensions already far advanced, or to those which were clearly necessary for reasons of economy or maintenance of equipment and buildings.

During the first part of the last year their engineers were fully occupied in supervising the technical details of their greatly expanded business. Upon the decline in business which followed, they have had more time to devote to improvements and economies in design of their apparatus. More attention has also been given to the design of special apparatus intended to meet novel conditions, and to the extension of their business along profitable lines.

The apparatus designed by their engineers for the long distance transmission of electricity has proved most reliable, economical and satisfactory in operation.

There has been a continued increase in the capacity of electric generators and transformers.

Their high tension switching apparatus has been still further improved, and they have been favored with the most important orders for such installations.

The details of the steam turbine-generators have been improved, great economy and proved reliability are now assured, and the turbine-generator is now standard for all new important electrical installations where steam is utilized. They are now building turbine units of a capacity of 14,000 kilowatts; the largest electrical generating units ever produced. The Commonwealth Edison Company, of Chicago, has now in operation in one station nine large turbines capable of generating a total of 103,500 kilowatts.

Their engineers have devoted considerable attention to the design of a line of turbine-generators for use with exhaust steam. Such steam turbines are so much more efficient than steam engines when operated by low pressure steam, that they can be most usefully employed to supplement steam engines in existing installations. Their use will result in large increases in output without any increase in coal consumption.

Their single phase alternating current railway equipments have been greatly improved during the last year.

Their new direct current railway motor, mentioned in the last report, has proved so satisfactory in practical operation that it is rapidly being adopted as the standard type. It marks an important advance in economy and durability.

They have extended the range of economical operation of direct current railway apparatus by designing it for use at 1200 volts, about double the existing standard, and have sold a number of such equipments to the Southern Pacific R. R. Company.

They have sold to the Great Northern R. R. Co., four 100 ton, three phase electrical locomotives, designed to handle all trains traversing the two and one-half miles of Cascade tunnel in Washington. This installation will be especially notable as the first instance of the substitution of electricity for steam on a mountain division of one of the Continental railways. The traffic conditions are peculiarly difficult on account of the grades and tunnels. These electric locomotives, because of their increased speed and better control, will practically double the traffic capacity of the present steam locomotives. Electricity for their operation will be supplied from water power hitherto unused.

A gas-electric car which fully meets the requirements of steam railroad companies for service on branch lines has been perfected. The equipment consists of a gasoline engine driving an electric generator which furnishes current to standard railway motors. The engine and generator are located in the forward end of an especially designed car, conveniently divided into passenger and baggage compartments, making a complete self-contained unit.

They have made many valuable improvements in the design of machinery for electric reduction of metals and in apparatus for various industrial applications.

They have shipped several large motors of special design of about 10,000 horse-power capacity each for driving rolling mills, and have received orders for additional equipments.

Important improvements in the design of their lines of wiring devices, rheostats, circuit breakers, switches, instruments, and other small devices, have been made during the year.

Their new tungsten incandescent lamp, which gives more than double the illumination of the carbon filament for the same expenditure of power, has been further developed and has now become a standard commercial article.

Several novel types of arc lamps of greatly improved economy have also been perfected and sold in large quantities.

OTIS & SQUIRES.

W. I. Otis and H. B. Squires, formerly with the California Electrical Works have opened offices at 111 New Montgomery St., San Francisco, as agents for the Columbia Incandescent Lamp Co. of St. Louis, and Machado & Roller of New York, whose line includes the Whitney Instruments, S. E. Circuit Breaker and Hartman & Brown instruments. This new firm is warmly welcomed among the local jobbers.

NEWS NOTES

OIL.

San Luis Obispo.—Advices state that the big refinery at Oilport is to be reopened for business on July 1st. Ever since the loss of the wharf during the heavy seas of last winter, the company has had its plant closed down.

San Luis Obispo.—It is reported that the Union Oil Company will construct a big refinery at Avila. Credence is given the report by the fact that the Lacey Manufacturing Company has just completed the construction of a 55,000-barrel storage tank at Avila.

San Francisco.—In April a cargo of refined petroleum was sent from this port to Manila by the British ship "Juteopolis," the quantity being 120,650 cases, or 1,206,500 gallons, and valued at $96,520. There were also 107,000 barrels, or 4,484,000 gallons, of crude oil shipped during the same month.

Los Angeles.—In the Sunset-Midway fields the extensive new development work of Kern County is being rushed to the full extent. In the Sunset field proper there is very little new work. Around the town of Maricopa a great deal of work is going on, the Fulton Oil Company having one crew at work on a new well and derricks up for two more.

Los Angeles.—The Union Oil Company is about to ship 25,000 barrels of crude fuel oil from San Pedro to Guatemala for use in the locomotives of the railroad that crosses Central America. The fuel for this line has been going from California through the Union Company for the past year or more, but this is the first shipment from San Pedro. The oil will come from Los Angeles and Orange County districts, which a year ago, or a little more, were unable to supply the home demand.

Bakersfield.—The Associated Oil Company is taking every barrel produced in McKittrick, and it all goes to the Southern Pacific, not a barrel of commercial oil going out at this time. Sixty cents is the ruling price for new contracts, and 50 cents is paid for daily runs, while there are a few old contracts still in force at lower figures. The Standard offers but 50 cents and is making no effort to get contracts. No oil has been run through the newly completed pipe that connects with the Bakersfield-Point Richmond line. The total shipments are around 7,000 barrels a day.

Bakersfield.—According to a so far unverified report, the Standard has purchased the lease of the Talara Oil Company on the west half of the southwest quarter, section 24, at Midway. The sale, if it has been made, has been carried out very quietly indeed, even for a Standard transaction. The Talara is controlled by W. S. Porter and O. Scribner, general manager and assistant general manager of the Associated Company, respectively. Its oil has been going to the Standard for some time past. The land is owned by J. W. Jameson. Colonel Babcock, of Titusville, Pa., is reported to have bought the lease of the Josephine, owned chiefly by John Connolly, of Midway, on the southeast quarter of section 23, which immediately adjoins the Talara, for $250,000. This is not yet confirmed. The Standard has attempted to buy other lands in Midway, and has been reported to be desirous of buying holdings from the Section Twenty-five Company, also those of the Mount Diablo. The last named has just brought in a new well at 1,000 feet.

TRANSMISSION.

Downieville.—The Plumbago Mining Company is arranging to move its power plant up to the mine, and after this has been accomplished, heavier machinery will be installed.

Rawhide, Nev.—R. O. Bioli, general superintendent of the Truckee Electric Power Company, with headquarters at Reno, is in camp at Rawhide to look over the situation relative to installing a branch of his company.

Los Angeles.—The power station at Holtville on the Alamo River is to receive extensive improvements, and an additional turbine and generator will be installed so as to increase the plant's capacity by 1,000 horsepower.

Independence.—The Four Metals Mining Company is repairing the road through Lone Pine Canyon of the Alabamas, preparatory to the construction of an electric power plant at the foot of the Sierras as soon as a permit can be obtained from the Forest Service.

Redding.—The Battle Creek Power Company, which is subsidiary to the Northern California Power Company, has given notice that it will appeal from the decision rendered recently in the Superior Court, wherein the Pacific Power Company and others were awarded $32,000 damages for land condemned on Battle Creek.

Placerville.—Otis Gibson has filed notice of location and appropriation of 20,000 inches of water of Rubicon River, to be used for irrigation, mining, municipal, domestic, mechanical, and electrical purposes. A power-house site near the junction with Pilot Creek is to be determined by later survey. Notice has also been filed on 5,000 inches of the water of Little South Fork of the Rubicon River to be diverted to Pilot Creek by ditch.

Berkeley.—Application has been made at the office of the building inspector for a permit to construct a concrete power transformer station on the ridge just back of the Spring Construction Company's quarry at the point where the Bay Counties Power Company's wires are brought into town on their way to Oakland. This power transformer station will prepare the electric current for transmission on small feed wires direct to the towns and communities where the current is sold. The permit was applied for by the Pacific Gas & Electric Company of San Francisco, a corporation allied with the Bay Counties Company. The constructing engineer is H. C. Vensano. The power station is to be 55x53 feet in dimensions and will cost $12,000, exclusive of the machinery that is to be installed.

TELEPHONE AND TELEGRAPH.

Honolulu.—There was a meeting recently of the Wireless Telegraph Company, at which it was unanimously decided by the stockholders that the plant and station at Kahuku should at once be commenced. Arthur A. Isbell, the expert who came down to make tests with a view to locating the proper site for the station, and who selected Kahuku, the site that was originally selected by Captain Niblack for the navy, but abandoned owing to the fact that there would be no guns there to protect it, was chosen as superintendent of construction to take charge of the installation of the plant and the erection of the station at Kahuku.

POWER AND LIGHT.

Spokane, Wash.—George Nixon, of the firm of Nixon & Kimmel, of Spokane, has been awarded a franchise by the Commissioners of Spokane County for the installation of a power plant to furnish heat, power and electric lights for the towns of Deer Park, Chattaroy and Milan. The line will be twenty-five miles in length. Mr. Nixon says he is able to develop all the power needed by a waterpower plant to be established on his property, one side of which is bounded by the Spokane River, near Deer Park.

Santa Rosa.—The contract has been let for the carrying out of one of the biggest electrical projects in Northern California, namely, the construction of a power line from the great generating plant of the Snow Mountain Power and Water Company, on Eel River, Mendocino County, through Ukiah, Hopland, Cloverdale, Healdsburg, Windsor, Santa Rosa, and on to Petaluma. The line has already been built as far as Talmage, two miles from Ukiah, and the poles and wire are already on the ground for carrying on the construction. It will be a big enterprise, and it is predicted that it will mean a big reduction in rates for power and light when the current is turned on.

Spokane, Wash.—One million dollars is the stated capital of the Northwest Light & Water Company, with headquarters at Carson City, Nev., which filed its articles of incorporation at Wallace, Ida., a few days ago. The incorporators are Robert E. Strahorn, of Spokane, president of the North Coast Railway Company; A. G. Smith, R. J. Danson and E. D. Doyle. It is generally believed at Wallace and Spokane that the light and water plants at North Yakima, Wash., Wallace., Ida., and Sumpter, Ore., will be consolidated. The owners of the Wallace plant are known to control the others mentioned, and it is believed that the filing of the articles of the Northwest Light & Water Company is simply an initial step toward the merging of these interests.

Spokane, Wash.—William T. Clark, of Spokane, president of the Wenatchee Canal Company, operating in the Wenatchee Valley, west of Spokane, and his associates composing the Valley Power Company, have ordered machinery for a $100,000 plant on the Wenatchee River, five miles above Cashmere, Wash. Four thousand horse-power will be developed, the plant to be in operation next fall. The company will furnish power to ranchers to secure water for irrigation. The Wenatchee Canal Company will use some of the power in boring a hole through Shotwell Hill, to do away with expensive fluming, and run the water through the hill. The company has undertaken the irrigation of several thousand acres of land.

Spokane, Wash.—The power plant to be constructed by a Portland syndicate on the Snake River will be at least 60,000 horse-power. When work on the plant was begun it was believed that at the lowest stage of the river only 36,000 theoretical horsepower could be developed, but daily gauges of the lowest stages of the stream show that at least 90,000 horsepower can be generated at the lowest stages of the river. Present plans call for a transmission system extending 350 miles, with numerous sub-stations in various directions from the main plant. Power will be furnished to the Seven Devils district, and to mines in Eastern Oregon. Twelve thousand poles for carrying the wires are now on the ground. The engineers are boring for a rock foundation for the dam on the Snake River, where the power is to be generated.

Spokane, Wash.—The Washington Power Company is negotiating for the overflow privileges on 6,000 acres of lowlands in the Coeur d'Alene Indian Reservation on the St. Joe and St. Maries Rivers in Northern Idaho. Surveyors have been working along these rivers since the first of the year, and the preliminary survey is nearly completed. The overflow of these lands is occasioned by the dam at Post Falls, Idaho, where one of the big lighting plants is now in operation. The level of the Coeur d'Alene Lake has been raised three feet above normal stage by the dam, and the backwater thus occasioned has covered thousands of acres along the Coeur d'Alene, St. Joe and St. Maries Rivers. Arrangements have been made with the settlers along the Coeur d'Alene River for the purchase of land thus affected by the backwater. Options covering nearly all of this land have been secured by the company, and many of them taken up. In numerous instances easement for overflow only is secured, while in others, the company purchases the land direct.

ELECTRIC RAILWAYS.

Yakima, Wash.—A. J. Splawn, president of the Yakima Transportation Company, states that his company has secured rights of way for nearly all of its proposed lines in the Yakima Valley, west of Spokane. The company expects to float $2,000,000 bonds so that work on the lines to Sunnyside, the Moxee and the Ahtanum may be constructed at about the same time. The branch to Cowiche, to serve ranchers on the Tiston irrigation project, probably will not be started until the district is opened. Cars will be in operation at North Yakima in September.

Spokane, Wash.—Frank McLean, engineer in charge of the Oregon & Washington Electric Railway Company, has filed on a 12,000-horse-power water right along the line of the proposed road to Lewiston, Ida., to Pomeroy, Wash. Contractors have been on the ground figuring for bids on the construction of the first ten miles of the road. The water rights were filed on under the name of the North Coast Power Company. This has led many to conclude that the electric road is a part of the line of the North Coast Railway Company, and that the division from Wallula to Lewiston is to be operated by taking advantage of the numerous creeks along the right of way.

Spokane, Wash.—Official announcement is made that the Snohomish Valley Railroad has been successfully financed in London, and that actual construction work on the first fifteen miles of the line will begin at once. This company was organized several years ago to build a line from Snohomish to Cherry Valley, but finding its proposition too small to interest the financiers of the East, it reorganized for the purpose of building a line to Renton, and from that point run lines to Seattle and Tacoma. The company is incorporated for $2,500,000, and has authorized a bonded indebtedness of like amount. The company has $500,000 in hand to begin operations.

Spokane, Wash.—Jay P. Graves, president of the Spokane & Inland Empire Electric Railway Company, has applied to the City Council of Spokane for a franchise for the construction of a line in Mendenhall Avenue, the continuation of East Riverside from Madelia Street and Olive Avenue to Sprague Avenue and Freya St, about two miles. This will give direct service to the Spokane Interstate Fair Association's grounds, four miles east of the heart of the business district. The Washington Water Power Company's tracks run on Sprague Avenue as far east as Lacey Street. They are one block distant from the south entrance of the fairgrounds. The traction line will cut in between this line and the grounds, and will deposit its passengers almost at the entrance. East Sprague avenue is the most traveled thoroughfare in the eastern part of the city, and a franchise for a street car line on it would be of more value than on any parallel avenue. It will be the first street car service extended to the district which was annexed last November. The ordinance requires that work shall begin within sixty days of the passage of the measure, and the line is to be in operation within a year.

POWER AND LIGHT.

Washougal, Wash.—C. L. Prichard has been granted a franchise for lighting the city.

Lewiston, Ida.—The ordinance granting to the North Coast Power Company the lease of a tract of land near the pumping station for the site of a power plant was passed.

Valdez, Alaska.—The Alaska Water, Light & Telephone Co. will spend $10,000 to $15,000 during the coming summer constructing dams and reservoirs for power purposes.

Hailey, Ida.—H. J. Allen has sent up a crew of five linemen to set up the poles and string the wires for his light and power plant from Trail Creek to the Independence mines.

Cottage Grove, Ore.—W. W. Oglesby has located a water right on Row river for what is to be known as the Cottage Grove Power & Electrical Canal. He appropriates 500,000 miners' inches of the water from that stream.

Pocatello, Ida.—The principal stockholders of the Bear Lake Electric Co. have decided to go ahead with improvements to the system. A new power house will be built and the power of Paris creek developed to full capacity.

Spokane.—George Nixon of the firm of Nixon & Kimmel of Spokane was awarded a franchise by the county commissioners for the installation of a power plant with which to furnish heat, power and electric lights for the towns of Deer Park, Chattaroy and Milan.

Wenatchee, Wash.—A franchise was granted to the Entiat Power Company containing the stipulation that the company should put up the sum of $850 in cash to insure good faith and to insure the delivery of electric power for heating and lighting into this city by November 1, 1909.

New Westminister, B. C.—The British Columbia Wood, Pulp & Paper Company of Vancouver has posted an application in Water Commissioner Fisher's office here for a record of 20,000 inches of water from the Cowholm river on Howe sound. The water will be used for the purpose of generating power to operate its pulp and paper mill.

Nelson, B. C.—Fire recently destroyed the substation of the West Kootenai Power & Light Company and the Municipal Power Plant Company jointly. The loss is estimated at $50.000. The Electric Tramway Company's plant, leased by the city, was entirely destroyed. The transformers of the West Kootenai Power & Light Company were also destroyed, as was also the switchboard belonging to the city.

GAS.

Los Angeles.—Robert Weiss has been granted a franchise to lay gas pipes in the streets of Ontario.

Azusa.—The Interstate Gas Co. is making extensive improvements in the Covina plant, and have installed a purifier capable of handling sufficient gas to supply a city of 10,000 people. New and larger pipes are also being laid, and it is the purpose of this company to give the people of this valley one of the best gas systems to be found anywhere. Vice-president J. V. Hoffman was in Azusa last week, and announces that the company will soon place $30,000 worth of 10-year, 6 per cent bonds on the market in denominations of $500 each. These bonds will be sold at par and the money will be used to lay the pipe for the Azusa-Glendora division. The officers of the company assure the public that the entire valley will be piped soon, whether the bonds are sold or not, but inasmuch as these bonds participate in the earnings of an established plant, it is believed the people of the valley will consider them a favorable investment.

TELEPHONES.

Grangeville, Ida.—A franchise was granted the Whitebird and Doumecq Mutual Telephone Company.

Grangeville, Ida.—A franchise was granted the Farmers' Telephone Line No. 15 to construct a line along the public road.

Grangeville, Ida.—A franchise was granted the Whitebird and Pittsburg Mutual Telephone Company to erect a phone line along the public road.

Cashmere, Wash.—Construction work by the Farmer's Telephone and Telegraph company began recently and will continue for several weeks. The entire system is being overhauled.

Montesano, Wash.—At a recent meeting of the city council a franchise was granted to C. H. Wolf & Co., which has taken over the lines and instruments of the Pacific States Telephone Company in the local field.

Montesano, Wash.—At a recent meeting of the city council a franchise was granted to C. H. Wolf & Company, which has taken over the lines and instruments of the Pacific States Telephone Company in the local field.

Baker, Wash.—The business men in this locality have organized a telegraph and telephone company under the name of the Skagit River Telegraph & Telephone Co., capitalized for $5,000, and will run a line from Concrete to Sedro-Woolley, working having been started. The officers are R. J. Kellogg, president and treasurer; E. C. Miller, vice-president, and J. K. Merz, secretary.

Spokane.—Construction will begin in a few days on a new telephone system at Fort Wright, which will provide 40 more instruments connected with the post exchange. Four trunk lines instead of one will give connections with the city. The telephone instruments provided by the government will be discarded and Pacific States Telephone Company telephones put in. A new and more modern switchboard will be installed in the headquarters building.

Bellingham.—Early in June Bellingham will have telephonic connection with Seattle, Tacoma and other cities of the Northwest, on two wires of the Home Telephone Company. The company has wires as far north as Mount Vernon. Poles have been put in as far as Bellville and in about a week two crews of men will be put to work between this town and Bellingham, one crew working north, the other south. The entire cost of the line will be about $50,000. The company will also do extensive work in Bellingham, enlarging its system to meet the demands of business.

INCORPORATIONS.

Fresno.—The Bishop Oil Company has been incorporated with a capital stock of $300,000 by C. A. M. Swain, W. G. Cochrane, L. A. Teague, E. R. and Ralph Bishop.

San Jose—Articles of incorporation have been filed by the Alviso Electric Light & Power Company, which was incorporated by G. L. Donovan, J. N. Thane, J. A. Belloli, Jr., Theo. Belloli, and L. E. Munier. The capital stock is $100,000.

Bakersfield.—Articles of incorporation have been filed by the Fresno Midway Land and Oil Company, with a capital stock of $25,000. The directors are L. Samuel, H. E. Barnum, E. J. Boust, H. C. McKamy, and S. L. Hogue, all of Fresno.

Port Angeles, Wash.—The franchise asked by the Port Angeles Railway & Terminal Company was granted by the city last week, but was amended in some minor particulars, but grants practically all that was asked by the new railroad company, which is believed to be controlled by the Chicago, Milwaukee and St. Paul.

Classified List of Advertisers

(Continued on second page following.)

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 23, 1908 No. 21

Inductive Interference with Telephone Circuits in Proximity to High Potential Transmission Lines*

By Elam Miller.

The matter of inductive interference to long distance telephone lines in proximity to high tension transmission circuits is a question that is becoming more serious daily. Telephone companies seem to have borne the brunt of many of the changes that have taken place in the development of other electrical industries operating overhead circuits. This effect was felt first in the local plants. Among the more important changes was the radical one originally necessitated by the introduction of the direct current electric railway on the then existing grounded telephone circuits, which required the installation of metallic circuits. A more recent development that has had a decided effect upon the open local wire plants is the introduction of the series alternating current arc circuit, which has forced many of these local telephone circuits into cable before the economical time to resort to such construction. The loss of revenue pending the latter changes and the premature expenditures necessitated thereby amount to many thousand dollars more than is probably generally realized. Though the matter of induction to local telephone circuits is, of course, a serious one, the general introduction of the all-cable plant has, in a measure, rendered this less so. In many of the smaller exchanges, however, this matter of alternating current arc circuits is still a troublesome one.

EXAMPLES OF POWER LINE PARALLELING TELEPHONE CIRCUIT.

The question of induction to local telephone circuits is, however, trivial as compared with the interference with toll service, which occurs to a greater or less degree wherever telephone toll lines parallel high tension transmission circuits for any considerable distance with, say, a separation of 60 feet or less. This considers practically all parallels on county roads, and these remarks are intended to apply particularly to such cases.

It is probable that this paper will prove quite incomplete without a preliminary consideration of the effect of electromagnetic and electro-static induction to telephone lines from

*Paper read before San Francisco Section, American Institute Electrical Engineers, April 18, 1908.

foreign electrical circuits with respect to the two sides of a metallic telephone circuit, or what may be termed "lateral" induction. As a result of the varying magnetic field surrounding conductors carrying alternating current, an electromotive force is induced by transformer action in adjacent conductors. If the adjacent conductors compose the two sides of an untransposed telephone circuit, it is evident that as one wire is nearer the power wire than the other and is consequently in a stronger field, the induced potential in this wire is greater than in the other. There is, therefore, at any instance a difference in potential between the two sides of the telephone circuit with a consequent flow of current through the terminal apparatus in order to equalize it. Under ordinary conditions lateral electro-magnetic induction can be readily overcome by transposition of the telephone circuit. Theoretically, one transposition in the exact center of the exposure, assuming that the separation between telephone circuit and power circuit is equi-distant throughout its length, will overcome this effect, and experiments have shown quite conclusively that one transposition ordinarily does.

As a result of the varying electric field surrounding a conductor having an alternating E. M. F., electro-static charges are induced in adjacent telephone circuits by simple electro-static induction. In this case, however, the explanation for current flowing through the telephone apparatus is somewhat less simple than in the case of electro-magnetic induction, and requires a diagrammatic explanation. It is also a fact that in the case of electro-static lateral induction the single transposition at the center of the exposure does not theoretically neutralize the effect and prevent the flow of current through the terminal apparatus. It can be shown that electro-static lateral induction can never be entirely overcome by transposition of the telephone circuit, but in practice it can be reduced so appreciably by sufficient and properly spaced transpositions as to render its effect unnoticeable. A particularly complete discussion of the effect of electro-static induction between adjacent telephone circuits, or "cross-talk," as it is called, will be found in a paper and subsequent discussion in the Proceedings of this Institute for 1891. The paper was prepared by Mr. J. J. Carty, the present Chief Engineer of the American Telephone and Telegraph Co. The remarks apply equally well to induction from adjacent telephone circuits or foreign electrical circuits. It is, of course, evident that both electro-magnetic and electro-static induction will usually take part in the creating of disturbance simultaneously. The relative importance of each is, in a measure, determined by the character of the disturbing circuit, but with the class of circuits that we are now considering, the effect of electro-magnetic induction is probably very slight. It is, perhaps, fortunate that a transposition scheme applied to telephone circuits calculated to overcome the effects of static induction, is all that need be considered, as these transpositions are usually more than sufficient to care for the electro-magnetic effect. The converse, however, does not by any means hold true.

In so far as lateral induction is concerned, telephone companies are in a fair way to care for themselves, as the disturbance is comparatively easy to reduce, or for practical purposes, eliminate. It is not, therefore, lateral induction that is a particular menace at this time, but an entirely different condition. I refer to the establishment of a difference in potential between both sides of the telephone circuit and ground, as follows:

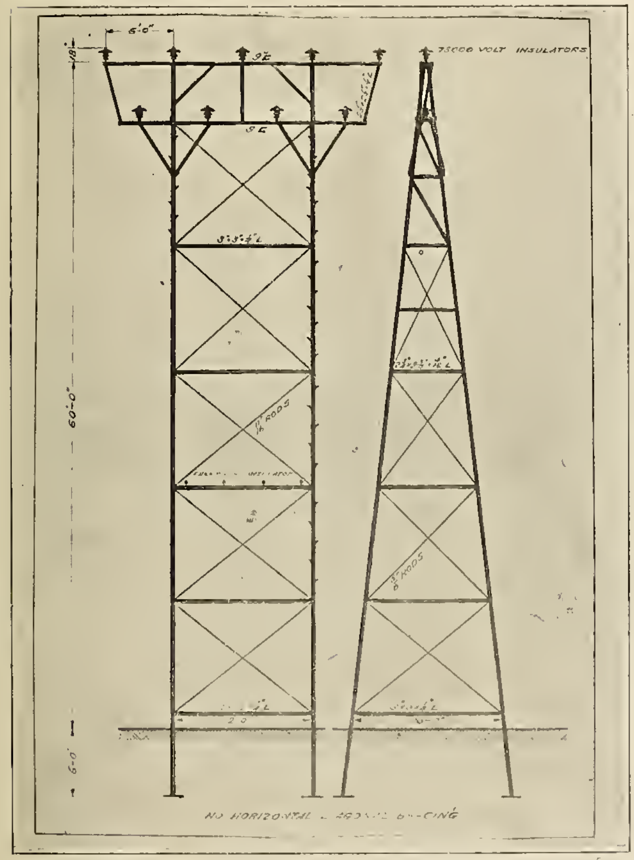
Consider two condensers in series, one having for its plates power and telephone line, both sides of the latter considered as one, and the other, the telephone line and ground. Assume for an instant for the power wire, a single wire having impressed upon it an alternating E. M. F., one side of the alternating current source applied to the wire and the other to earth. As far as the static effect which we are now considering, is concerned, the wire need not be carrying current, so that we may consider it open at the far end. The flow of charging current, and consequent fall of potential from power wire to earth, takes place through these two air condensers, and by considering the capacity reactance of each, the distribution of potential can be shown to be inversely proportionate to the separate capacities. Such a condition would, of course, only obtain on a high tension transmission circuit, where the circuit was operated with a "Y" connection and a grounded neutral, when two of the phases were temporarily out of commission. The condition, however, that does obtain in practice and with the three-phase power circuit in perfect balance, is due to the potential impressed upon the telephone wires as a result of the fact, in that the three phases of the power circuit have an appreciable separation as compared with the separation between any one of the three and the telephone circuit, that the potential that is impressed upon the latter is greatest from the power wire nearest it, the neutralizing effect of the other two not being complete because of this difference in distance. This, of course, applies only when the power circuit is untransposed. Theoretically, therefore, the only position that a telephone circuit can occupy and be in a perfectly neutral static, and for that matter magnetic, field with relation to an untransposed but balanced three-phase system, is the center of an equi-lateral triangle formed by the three-line wires of the circuit. Further, in order that the two sets of circuits may be perfectly symmetrical, the two sides of the telephone circuit would necessarily be spiralled, as with a twisted pair. The consideration of such an arrangement is, of course, an absurdity. In so far as the actual difference in potential between telephone circuit and ground is concerned, due to this effect, it obviously largely depends on the voltage of the power wires to ground. This in the case of a three-phase transmission circuit "Y" connected with a grounded neutral with 60,000 volts between phases, which gives a potential between any one phase and ground of 60,000, or, say, 35,000 volts, has, with varying lengths of exposure at various separations, been noted to have varied between about 80 volts and 750 volts. In order to predetermine by calculation the induced potential between telephone circuit and ground that may be expected it would be necessary to at least have the following data:

Telephone Circuit—Size of wire; length of circuit; distance above ground.

Power Circuit—Size of wire; how connected—delta or star; potential above ground; distance from telephone circuit; distance parallel to telephone circuit; distance between power wires.

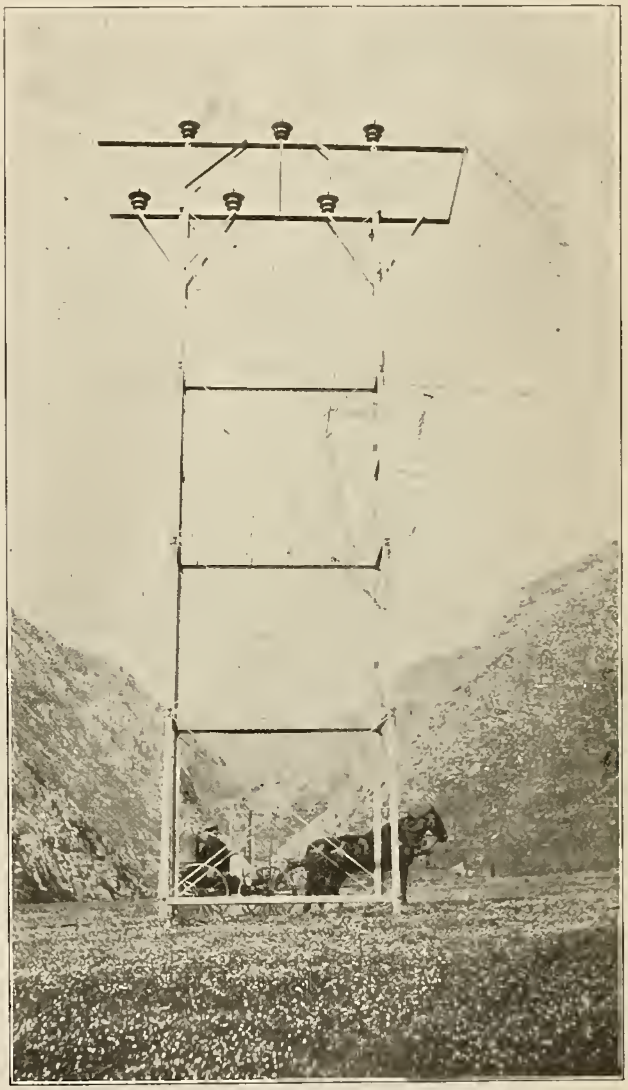
This information will, in a measure, permit of an approximation of the disturbance that may be expected from a given exposure, but the actual effect is so varied by other conditions that it has been our experience that any attempt to predetermine the effect of an exposure is usually unsatisfactory. Before considering further the effect of the establishment of a difference in potential between telephone line and ground, it should be stated that the amount of current flowing through the receivers at either end, which will ordinarily render the average long distance conversation unintelligible, depends largely on the transmission equivalent of the telephone circuit. It is a fact, however, that current in excess of 10 micro-amperes superimposed upon the voice current will ordinarily produce sufficient disturbance to interfere greatly with long distance telephone transmission. By considering the following it will be understood why the establishment of a difference in potential between the telephone loop and ground almost invariably results in interference. Were it possible to maintain the insulation resistance and dielectric strength, together with the capacity

of the two sides to ground, at exactly the same figure, it is, of course, evident, that, irrespective of the potential that existed on the two sides of the loop considered as one, no current would flow through the terminal apparatus. This, however, is a condition that even with the most perfect maintenance is obviously impossible. On all commercial lines it is an invariable fact that there is some difference in the insulation resistance to ground of one wire as compared with the other, and also that the other factors vary. If, therefore, this is the case, it is evident that there is a flow of current to ground from one wire greater than from the other, and a consequent flow of current through the receivers at either end in order to equalize the potential of the two sides. With a comparatively low impressed potential on the telephone circuit this difference in insulation resistance, dielectric strength or electro-static capacity



STEEL TOWERS WITH HIGH VOLTAGE AND TELEPHONE INSULATORS

may be sufficient to result in the flow of enough current through the receivers at either end to produce an appreciable effect. It must also appear evident that transposition of the telephone circuit leaves the case practically unaltered. In order, therefore, as a preliminary to prevent as much as possible the establishment of a difference of potential between the two sides of the telephone loop and ground, it is evident that the power circuit must itself be transposed. This transposition of the power circuit, to be theoretically correct with respect to the paralleling telephone circuit should, of course, make one complete barrel opposite the exposure. If the separation is the same for the entire length of the exposure the transpositions should be made equi-distant so that the power line will be divided into three equal lengths, assuming, of course, that we are considering a three-phase circuit. If, however, the distance varies, it is necessary to calculate in each case the location of the power transpositions. While observation does not indicate that it is strictly true, it is probable that for practical purposes the inductive effect of the power circuit on the telephone circuit, length of exposure remaining constant, will vary as the square of the separation, and the location of the power transpositions, where the exposure varies in separation from one end to the other, should be calculated with this in view.



STEEL TRANSMISSION TOWER.

It is, of course, evident that transposition of the power wires is effective only under conditions of perfect balance. If the three phases vary appreciably under normal conditions in potential, a transposition scheme such as has been suggested would be useless. Further, in the event of the grounding or opening of one or two of the phases the transpositions are also useless. Just what variation in potential may be expected under working conditions we should be interested in knowing, as we have been inclined to attribute the disturbance, due to several exposures, in a measure to this cause.

We have had occasion in a number of cases to observe that the disturbance is more pronounced and somewhat different in character where the exposure is to a three-phase circuit, operated with a Y-connection and a grounded neutral, than to a circuit operated with a Delta connection or a Y-connection with the neutral ungrounded. It is readily possible to note the difference between a disturbance

caused by a frequency of say, 60 cycles, and that by an appreciably higher frequency. In the discussion which followed a number of papers on the Grounded Neutral, presented before this Institute recently, Dr. Steinmetz called attention to the fact that with a grounded neutral effects were frequently set up which gave rise to an E. M. F. between the three phases and ground of triple frequency. This E. M. F. he describes as existing between the line and ground, and states that it may cause a rise in potential to ground above the normal value of as much as 40 per cent or more. Further, it is stated that currents of triple frequency are also caused to flow over the three line wires and return through the neutral. Assuming this to be true, the condition is evidently a serious one, as we have the equivalent of a single line, the three lines considered as one, with a ground return. It is evident that transposition of the power circuit is here quite useless. Further, both electro-static and electro-magnetic induction may both enter largely into the establishment of the difference in potential between the telephone circuit and earth, the E. M. F. causing this as described in the first portion of the paper, and the current also entering, due either to the difference in distance between the telephone circuit and power wire and telephone circuit and ground, or the tendency on the part of the current to follow paths other than directly beneath the circuits, and thus because of the lack of current density and consequent weakening of the field, the return current exerts an incomplete neutralizing effect. It is, of course, of little consequence whether the difference in potential between telephone line and earth is caused by electro-static or by electro-magnetic induction, but that this difference in potential is established is certain, and it seems not improbable in the manner suggested in this instance by both electro-static and electro-magnetic induction.

We have quite recently had an experience wherein certain of our circuits had been paralleled for some years by a 15,000-volt transmission system at a separation varying from 10 to 60 feet for a distance of approximately 12 miles. The total length of telephone line was in the neighborhood of 70 miles, and the exposures occurred at rather widely separated sections. Until such time as the grounded neutral was used on this system the inductive effect was unnoticeable. Immediately, however, upon placing in service in multiple with this transmission line, a plant operating with a grounded neutral, the disturbance became such as to render certain of our lines absolutely uncommercial. The high pitch of the disturbance was most noticeable in this case.

In the first part of these remarks the statement was made that on lines where inductive trouble was being experienced, difference in potential to earth varying between about 80 and 750 volts had been noted. That under ordinary maintenance conditions potentials of these magnitudes will in general cause considerable annoyance and under certain conditions, render transmission impossible, we know from experience. The existence of such potentials has on several occasions been questioned, and attention has been called to the fact that an ordinary alternating current voltmeter will not register it. This is a fact, but the explanation is simple. The introduction of an alternating current voltmeter of ordinary resistance partially destroys the air condenser, and values registered by the instrument are frequently not over 10 per cent of the total value. This point was brought out quite clearly by a series of experiments that we had occasion to make several years ago.

Between a particularly exposed telephone loop and ground a 16-candlepower 110 volt lamp was first placed. The lamp glowed dimly, and it was estimated that about 0.2 amp. was flowing. Next, a 2,100-ohm. Weston alternating current voltmeter of the dynamometer type was cut in series with the lamp. The voltmeter registered to 125 volts, but was thrown off the scale. The lamp glowed just as before, indicating the same flow of current through the additional resistance. Next, 5,000 ohms. (non-inductive) was placed in series with the voltmeter. Under this condition the voltmeter registered 122 volts, and by considering the non-inductive resistance as a multiplier to the voltmeter, the line voltage is fixed for this arrangement at 411 volts. Additional resistance was by steps cut in series with the voltmeter until the final voltage under these conditions indicated 610 volts. I say the final voltage under these conditions, as it then seemed evident that this method of measurement was an improper one. In addition to this, it was discovered that there was a limit to the available resistance. Subsequently, a series of tests were made by alternately charging a standard condenser from the line and discharging it through a Ballistic galvanometer. Readings on either side of the center of the galvanometer scale were taken, but only the highest figures were considered. The same condenser was then charged from a battery of known potential and discharged through the same galvanometer, and the two sets of readings compared. This indicated a maximum potential of 730 volts. Similar tests have on other occasions been made, using a standard condenser of one-third manufactured capacity, and an ordinary Weston direct current voltmeter. The voltmeter is, of course, merely used as the galvanometer in the former case, and the deflections, therefore, bear no particular relation to the scale readings.

Probably one of the most pertinent questions that can be brought up is: "With a given length of exposure just what separation do we consider essential when paralleling a high potential lead of a given voltage?" Though it may at first sight appear simple, I doubt very much if today even a reasonably definite reply to such a question could be made. With respect to the telephone circuit, so very much depends upon the condition of the line throughout its entire length, the amount of open wire, amount of cable, kind of cable, type of terminal apparatus, type of central office equipment at terminal stations, transmission equivalent of the entire circuit, number of wires on the lead, general importance of the lead, the possibility of its future importance, whether or not phantom circuits are being operated at present or whether or not they are contemplated in the future, and an almost indefinite number of other points, all of which would have an effect upon such a decision. In the first portion of these remarks attention was called to some of the principal points to be decided with respect to the power lead.

There are two other points that I wish to bring out with respect to inductive trouble that are generally admitted to be rather important. The first of these is the fact that the circuits composing our main toll leads frequently cover considerable territory, but that they are usually finally concentrated on one route. It is, therefore, quite possible for a relatively unimportant toll circuit exposed to a high potential line at some point in its length to, by secondary induction, affect a whole lead, many of the more important circuits in this way suffering from the effects of this apparently unimportant exposure.

The second point, and one of the utmost importance to telephone companies operating an extensive toll plant, is the phantom circuit situation. Wherever the margin of transmission is sufficient, preferably on two similar adjacent circuits, it is possible to obtain a third circuit by using for each side of the third circuit, the two wires of each of the metallic circuits in multiple. This is accomplished by means of specially balanced repeating coils, placed one at each end of each of the two metallic circuits. The third, or phantom circuit, is taken off from the mid points of the secondaries or line windings of these repeating coils.

I believe we may almost positively say that wherever inductive trouble is being experienced, even though we are able to operate physical circuits commercially, a phantom will prove absolutely inoperative. The reason for this seems fairly clear. As the phantom circuit has twice the exposure of a physical circuit, and approximately twice the chance for leakage or capacity unbalance, the foreign current through the terminal apparatus should be approximately four times as great as upon either of the physical circuits forming it. That the inductive effect upon phantom circuits is great, experience has proven. Wherever it is possible to do so, there is little question of the economy of phantom circuits, as by this means additional circuits can be obtained at but a small fraction of the cost of additional physical circuits. The inability to phantom physical circuits because of high potential exposures involves a serious loss of revenue or unnecessarily heavy expenditures.

It would, perhaps, be impossible to emphasize too strongly the desirability of commercial telephone lines being as far removed as possible from all sources of foreign electrical interference, and most particularly from high tension transmission circuits. There is little reason for becoming unduly enthusiastic over this point, however, as it is certain that under some conditions exposure to high tension circuits will always exist.

Admitting, however, that the situation is a bad one, and should not exist if there is any possibility of avoiding it, let us see what curative, or at least palliative, measure may be considered. The first is, of course, increased separation as the effect varies approximately as the square of the separation, length of exposure remaining constant. The next should be the transposition of the power lead as described previously. This is probably least effective where the power circuit is operating with a grounded neutral. Another means is the paralleling of the telephone circuit with a grounded wire or wires, which tends to increase the capacity of the loop to earth and thus reduce the difference in potential between loop and earth in accord with the previously advanced theory that the difference in potential of the telephone loop and earth is dependent upon the capacity between telephone loop and power circuit and telephone loop and earth, and that the capacity between telephone loop and power circuit remaining constant, its difference in potential to earth will vary inversely as its capacity to earth. The paralleling of a telephone circuit with grounded wires is, of course, a rather expensive expedient if the exposure is of considerable length and is in the case of a heavy lead frequently impossible. It must also appear that in most cases this expedient is highly impracticable. There is still another means which may occasionally be employed if the margin of transmission is sufficient, and that is, the isolation of the section of telephone loop opposite the exposure by means of repeating coils. The potential is evidently impressed at the exposed section only, but the current may leak to ground from one side more than from the other side of the loop at any point on the line. The isolating of the exposed section limits the possibility of an unbalanced condition of the loop to this section, and permits of both careful original insulation and balancing and careful future maintenance of this section. Further, it in a measure prevents the line or lines at the exposure transferring by secondary induction the disturbance to other circuits which they may later parallel. A scheme of this sort is, however, seldom to be recommended, as it introduces transmission losses which cannot usually be justified, and that are frequently sufficient to render the line uncommercial when its equated length approaches the commercial limit of about 30 miles of Standard cable. It is probably appreciated that a properly engineered telephone toll line contains no more copper than is necessary to bring the transmission within a certain limit, and that anything tending to increase its equated length means either a loss of revenue because of its unsatisfactory operation or an increased expenditure in order to increase its transmission efficiency. The engineering problem in long distance telephone transmission is, of course, to so design the line, switching and terminal apparatus that a predetermined quality of transmission will result with a minimum ultimate expenditure. This is frequently impossible, if, after laying out and constructing long distance circuits, factors other than those originally considered arise.

The rapid extension of both high tension circuits and telephone lines on the Pacific Coast in particular renders an earnest and early consideration of the problem of inductive interference to long distance telephone service a most important one.

These remarks are admittedly most incomplete, but all that they are intended to accomplish at this meeting is to call attention to the genuine seriousness of the situation and to request the co-operation of operating high tension engineers whenever the occasion arises.

The discussions on this paper will appear in the issue of May 30, 1908, "Journal of Electricity, Power and Gas."

TELEPHONE TROUBLES.

Can hear, but cannot talk: Cause—Primary circuit open.

Speech indistinct with a bubbling, buzzing sound: Cause—Loose connection at microphone.

Rings other bells feebly but its own bells strong: Cause—Generator weak or armature adjustment bad.

Bell rings frequently without apparent cause: Cause—Swinging cross with telegraph or other lines.

Spluttering or grating noise in telephone receiver: Cause—Loose connection at battery, transmitter, or hook.

Rings other bells strong but its own bells weak: Cause—Ringer magnet weak or armature adjustment bad.

Receives a ring but will not ring its own bells: Cause—Wire broken in generator or armature short circuited.

Can ring, but can get no response: Cause—Line badly grounded or broken and grounded, if bridged line open.

Rings, but cannot talk: Cause—Broken cord, bad connection, or hook does not go up to place, line open if bridged.

Speech received is strong, but transmitted is weak: Cause—Speaker stands too far from telephone or the battery is weak.

Cannot ring or receive a ring: Cause—Wire broken in office or line, short circuit if bridged metallic, grounded if bridged to ground.

Bell will not ring: Cause—Broken wire in bell box, line or ground wire, short circuit if bridging is metallic, or grounded if bridged lines.

Receiver weak: Cause—Bad connections, diaphragm bent or dirty, position of diaphragm not correct (should be 1/32 inch from magnet), or permanent magnet weak.

Receives and transmits a ring feebly: Cause—Bad connections in bell box or poor ground, resistance cross if bridging metallic, resistance ground if bridged grounded line.

Two bells ring together or two switchboard-drops fall: Cause—Office wires or line wires crossed if on common return wire, return wire broken, or annunciator ground broken.

EVOLUTION OF CAST-IRON PIPE.*

(Continued.)

Life. In these days, in selecting pipe for underground service, the engineer naturally turns to cast iron pipe as the most durable. While we do not know when pipe were first cast, there are well authenticated instances of cast iron mains in service to-day, which were laid more than two hundred years ago, and such pipe have now been in general use more than one hundred years. In 1901, at Versailles, France, an acquaintance of the writer saw repairs being made to a line of cast iron pipe leading to one of the palace fountains, which probably had been laid more than two hundred years. It is said that these pipes were put down in 1685. The fracture, due to subsidence, showed inside a clean pipe of good gray iron, but little rusted outside; the natural result with good water and subsoil conditions. In London, the first cast iron pipe we know of for water were put down about the year 1800. The eight London undertakings–the great water companies–are now vested in the "Metropolitan Water Board," and in a recent letter the Chief Engineer, William B. Bryan, Esq., writes: "As chief engineer, for many years, of the late East London Company I have had numerous opportunities of seeing old mains that had been in use for ninety years, and which, when taken up, were in perfect condition." In this country cast-iron pipe have been used for fully one hundred years. Some of the earlier pipe were imported, but the making of cast-iron pipe received early attention, and the industry has now grown to large proportions. In Philadelphia, following the use of bored logs, cast-iron pipe were first used about the year 1804, and since 1820 have been exclusively used by the water department. Numerous instances might be cited of pipe in use to-day which were laid more than a century ago, all tending to prove the long life of cast-iron underground. Thus, cast iron as a material has long been accepted as the standard for underground mains, and it is not surprising, therefore, to find cast-iron water and gas mains used almost exclusively in the cities and towns of this country and Europe.

"LOG PIPE." BORED LOGS LAID IN PHILADELPHIA BEFORE 1820.

THREE LINES OF 60-INCH CAST IRON PIPE.

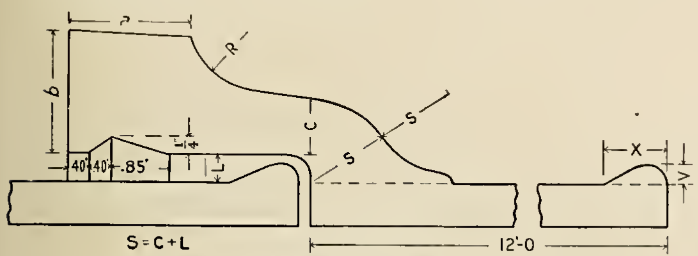
Length.—In the early stages of the cast-iron pipe industry, short-length pipe were made; in France, about one meter in length; in England, about thirty inches; then came longer lengths, six and nine feet. The earlier joints were usually flanged, and these being found to be too rigid, were shortly followed by other forms, from some of which were evolved the turned and bored socket and spigot, similar to those to some extent to-day used abroad, and these in turn have been largely superseded by the standard bell and spigot joint calked with lead. Thus experience gained from the earliest days in the making and use of pipe has developed our present lines, as indicated by Standard Specifications as adopted or proposed by the leading manufacturers and the several water works and gas light associations throughout the country, which cover pipe cast vertically in dry sand, in lengths to lay twelve feet, with standard forms of bell and spigot.

*Contributed by R. W. Martindale.

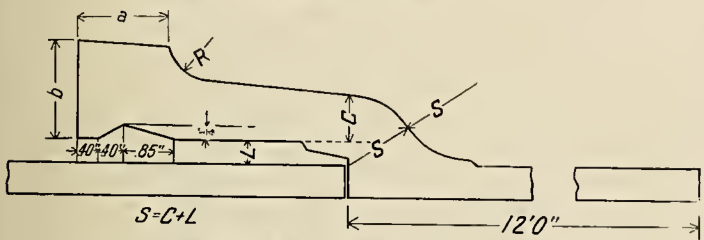
Dry vs. Green Sand Pipe.—In casting pipe vertically in dry sand, the use of core chaplets is avoided, and the twelve-foot length insures a much smaller number of joints in the main as compared with short-length green sand pipe which are cast on the side, "on the bank," in nine and six feet and even shorter lengths. Aside from the greater number of joints resulting from their use, these green sand pipe are liable to be of uneven thickness, and also to leak through imperfections in the pipe shell, which are due to the process, such as blow holes, or which result from the use of anchors to support the cores in casting on the side. These anchor spots are sometimes concealed by bosses or knobs, which form but a thin covering; thus, covered up, these defects are hard to discover, and often withstand the pressure test, but when buried in the ground will sooner or later develop leaks, or even cause the pipe to break. Such pipe, also, are usually of light weight with thin walls, are illy adapted to permanent mains, and form anything but substantial construction. The thin pipe shell will easily break under shock or subsidence, and the metal in the pipe, because of the process, has a tendency to hardness and brittleness. It is because pipe cast vertically in dry sand are so markedly superior, that the leading manufacturers of cast-iron pipe have some time since abandoned the manufacture of green sand pipe.

Joints.—In the operation of water and gas works, engineers are now more concerned with the question of leakage, and to reduce it, one or another form of joint has been tried, the bell and spigot being that now most generally used. This is because the bell and spigot joint, when well made, is the most flexible, allowing for expansion and contraction without affecting its tightness. Such joints are safely used in high pressure fire line pipe and other hydraulic pressure mains. We also show another type of bell and plain end pipe joint which is made up and calked with lead in the usual way. This design is used abroad and is substantially the same as is required by the Public Works Department of the Netherlands, at The Hague. It is claimed the plain end is more easily centered in the beveled bottom to the bell than is the ordinary spigot, and that the bevel in the bell more satisfactorily makes up with cut pipe. As to the turned spigot and bored bell joint, it is claimed that in being practically a metallic joint it does not leak unless it is broken through subsidence of the ground, or through accident. To allow

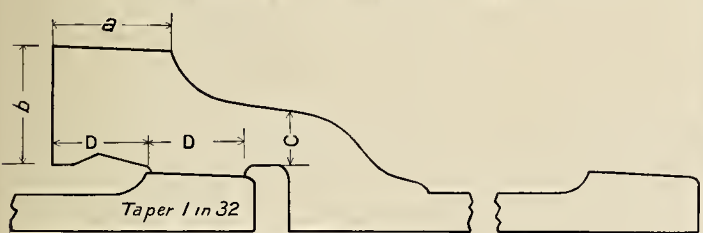
for expansion and contraction, some engineers for every tenth joint use a socket and spigot calked with lead, while others claim to have no trouble on this account, no doubt because of location. For underground service, a bolted joint, whether flange or of other form, should be avoided as too rigid, and because the bolts are liable to rust. An iron to iron joint, whether of conical or ball type, is in no sense a flexible joint, but is liable to rust fast in whatever position it may be laid. There is nothing new in such joints, as certain old French and other patents will testify. If an iron to iron joint is preferred, it should be of the turned and bored type, without bolts.



STANDARD BELL AND SPIGOT.



BEVELED BELL. THE DUTCH TYPE.



STANDARD BORED BELL AND TURNED SPIGOT.

Making Joints, Bell and Spigot.—In laying cast-iron pipe having bell and spigot joints calked with lead, care should be taken in making the joint to wrap sufficient yarn around the spigot before entering the bell, then to pack it in with calking tools before running the lead, which should then be well calked up against the yarn. On well-laid water mains of cast iron, a leaky bell and spigot joint is extremely rare. Some of our friends claim that they do not have any, and recently, an engineer in a prominent Eastern city, advised of having uncovered last year several miles of cast-iron bell and spigot water mains without finding a single leaky joint; evidently these lead joints were well made. Note the photograph of a 48-inch cast-iron bell and spigot main, near Lardner's Point, Philadelphia, as under pressure it was being shifted to one side, and afterward raised onto the ledge. During the shifting of this line of 48-inch pipe, the regular water pressure of sixty pounds was not turned off, and the only evidence of leaks at the leaded joints was a seepage readily stopped by recalking when necessary. To do this was a severe test of the bell and spigot joint, as to flexibleness and tightness.

Bell and Spigot Joints, in which, instead of lead, the socket in the bottom and annular space surrounding the spigot is filled with wood and carefully calked, have proven tight, and are thought to so insulate the joint as to materially lessen, if not prevent, electrolysis. It is too soon to speak of this assuredly, but encouraging results are said to have been obtained within the past year with joints so made.

Turned and Bored Joints for water or gas pipe, as used abroad, are rapidly laid and are perhaps more extensively used for water than for gas. This general type of joint is still exclusively used in many prominent foreign plants, while it is scarcely used at all in the United States. We again quote from another recent letter from William B. Bryan, Esq., Chief Engineer, Metropolitan Water Board, London:

"In my own practice I have used immense quantities of turned and bored pipe, and I certainly think that these pipe, where streets are straight and there are no obstructions to cause deviations, have very great advantages. The greasing of the joints and placing them gently into the sockets of the next pipe, and centering them perfectly, makes a joint which is practically water tight of itself, but in all cases the socket is run with molten lead and set up in the usual manner." In making joints for gas, red lead or sal ammoniac is used and the pipe driven together, in some instances, without running in the lead and calking; but where this is done the joint is so designed, that in case of a leak it may readily be calked with lead or made good with cement. With turned and bored pipe we supply special castings of our standard dimensions, with bored bells all around. While without the use of special curves the turned and bored joint pipe may only be laid in straight lines, very often long or easy curves are made in lines of full-length bell and spigot pipe. An instance of this is shown in the photograph. A slight adjustment in the bell when laying is possible in the standard bell and spigot joint.

POURING A LEAD JOINT.

48-INCH CAST IRON MAIN MOVED WHILE UNDER PRESSURE.

(To be continued.)

THE JOURNAL OF ELECTRICITY
POWER AND GAS

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
111 New Montgomery St., San Francisco, California

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MAY 23, 1908 No. 21

EDITORIAL.

THE TELEPHONE EDITION.

This issue of the "Journal of Electricity, Power and Gas" is, in a measure, typical of the proposed Telephone Edition to be published in the second number of each month, commencing during July, 1908. For fifteen years past the "Journal" has chronicled telephone news west of the Rocky Mountains, together with occasional descriptive and technical articles. These will hereafter be segregated to appear monthly, not only for the benefit of our regular readers, all of whom are telephone users, but also for telephone specialists.

The editorial stand will be independent and unbiased. Recognizing the great possibilities for telephone development in this Western field, we are preparing to exploit them by telling the world precisely what is being done. New telephone installations which are noteworthy, either in point of size or because of unique features, will be described in full, and accounts of new apparatus, new patents, and other pertinent data, together with articles that will be interesting to both the layman and engineer, will be published. A practical telephone man will take charge of this bureau. He will be able to answer the many questions that arise in connection with telephone work and will be willing to tell what he has learned during many years of experience. The aim will be to relieve the dull tedium of purely technical articles by live matter of general interest.

TELEPHONE DIFFICULTIES.

Complacently engaged in substituting cable for wire, experimenting with concrete poles, investigating duplex systems, designing satisfactory subscriber's instruments, installing automatic ringers, and putting in service meters, the telephone engineer has been rudely awakened by the fact that his most perfect systems are being made inoperative because involuntarily forced to act as transformers for near-by high-tension electric power circuits. The telephone field may be likened to a peace-loving citizen, who has nicely settled himself in a quiet, sunny cottage in a beautiful suburb, which is suddenly recognized as an ideal manufacturing site. Succeeding the din of construction are noise and dirt, which he must endure either until ameliorating regulations reduce them, or until he is forced to abandon his home. If the owner lives in the same neighborhood, the former is the more likely alternative. Fortunately the same thing is true of the telephone situation, and insomuch as power companies are themselves the most seriously affected telephone users, they are likely to devote all their energies to remove the difficulty.

In this issue Mr. Elam Miller calls attention to the "Inductive Interference with Telephone Circuits in Proximity to High Potential Transmission Lines." He shows that with the increased potential and more general application of the electric current for power and light, satisfactory telephone service is becoming more and more difficult. Already mere transposing or spiralizing of the telephone lines have proved insufficient and various counteracting devices but little better, as a means of equalizing the potential. In the mathematician's parlance it is difficult to establish a differential suitable for typical integration. Because of electro-static and electro-magnetic induction, telephone wires are rendered unfit for transmission of conversation.

Having shown that his troubles are due to the power lines, the telephone engineer naturally looks to their designer for aid. As palliative measures he has paralleled telephone circuits with grounded wires and has put in repeating coils to isolate exposed sections. But while these may be all right in theory, in practice they are not wholly satisfactory on account of the great expense of the former and the transmission losses of the latter method. Consequently he proposes that the power circuit be transposed in order to minimize the difference of potential between the two sides of the telephone loop and ground. This in itself is an excellent suggestion wherever the grounded neutral is not employed. In the discussion that followed (which will appear in our next issue) representatives of the power companies showed that much of the trouble was due to grounding and leaks, which could be avoided by better attention to the line.

But until these various improvements can be perfected, common sense would suggest divorce as the best solution of the problem, alimony to be eliminated and priority to govern occupation. In other words, neither a power nor a telephone line should be allowed to parallel the other within a distance of say sixty feet, which may be assumed to be a safe limit. Nor should either be forced to bear the burden of the expense. In long distance transmission, power lines seldom parallel the commercial telephone lines, and in distribution mutual co-operation will accomplish far more than opposition.

PUBLICATIONS RECEIVED.

"Telephone Construction, Installation, Operation, Wiring and Maintenance," by W. H. Radcliffe and H. G. Cushing, has been recently issued by the Norman W. Henley Publishing Company, of New York City. This book is intended for amateurs, wire men, engineers and contractors desiring to make local telephone installations, being written in simple language without intricate mathematical terms. After an elementary description of the common forms of receivers, transmitters, batteries, and other details of telephone instruments, the authors describe wiring methods for different kinds of installations. The following chapters on inspection and maintenance of telephone instruments are particularly valuable. All the details of telephone line wiring are illustrated by drawings and diagrams that give a quick understanding of the subject. The remaining chapters are devoted to tests of telephone line work and cables, and the wiring and operation of special telephone systems. The book contains 170 pages and is well bound. It will be sent postpaid for $1.00 by the Technical Publishing Company.

"Tables for Engineering Calculations," by Richard C. Powell. A second edition of this valuable compilation has been reprinted and contains enough new matter to nearly double its former size. It contains a collection of formulae and tables for nearly all engineering calculations; descriptions and illustrations of the apparatus having been omitted. This includes tables of logarithms, trigonometrical functions, circles, functions of natural numbers, conversion units, and other mathematical tables. There are few requirements of the civil engineer that have not been met. Standard tables upon heat are all that have been given specially for the mechanical engineer. Magnetic, electrical and transmission line constants, including the necessary data for wiring and cables are available to the electrical engineer. The data on hydraulics is particularly valuable. It is difficult to criticize a book of this character, because it is impossible to include in one volume of 200 pages what is needed by every engineer. The author has shown great discrimination in his selections. The book is handsomely bound in flexible leather and will be sent postpaid for $2.00 by the Technical Publishing Co.

MEETING NOTICE.

"The Horn Type Arrester Automatic Circuit Breaker" will form the subject for discussion at the meeting of the San Francisco section of the American Institute of Electric Engineers, 8 p. m., May 29, 1908, Franklin and Ellis Streets. Mr. A. J. Bowie will present a paper on this subject, which will be discussed by local engineers.

TRADE CATALOGUES.

The Jandus Electric Company, of Cleveland, Ohio, send a handsome pamphlet illustrating and describing Daniels' boulevard lighting system.

PERSONALS.

George A. Scoville, San Francisco engineer of the Dean Electric Company, of Elyria, Ohio, is making an extensive trip throughout the Northwest.

Jos. R. Mathews, electrical engineer for the Northern Commercial Company, of Fairbanks, Alaska, has left for Seattle after a three weeks' stay in San Francisco.

J. E. McGillivray of the American Electric Telephone Co. returned this week from a five weeks' trip through Washington, Oregon, Idaho and Utah, and reports considerable activity in the construction of new telephone lines and plants throughout the country.

Mr. Richard Spencer, manager of the California Electric Company, of Los Angeles, is in San Francisco for a few days. He has just returned from a two months' business and pleasure trip through the East, and reports that conditions in that section show continued improvement.

C. G. Vickery, formerly general superintendent of the Utah Independent Telephone Co. at Salt Lake, has recently resigned and returned to Rochester, New York. He is succeeded by Fred B. Jones. Mr. Jones was formerly superintendent of construction and has been identified with the plant since its inception.

Mr. Eben C. Dodge, president and general manager of the Battery Supplies Company, manufacturers of Gladstone La-Land batteries, Newark, N. J., has just reached San Francisco from Los Angeles, in the course of a trip taking in the Pacific Coast. This is Mr. Dodge's maiden visit to the coast, and he is greatly impressed with the vast amount of work which has been accomplished in the reconstruction of San Francisco.

After serving a little over two years as treasurer of the California Electrical Works and assistant treasurer of the Western Electric Company at San Francisco, R. W. Van Valkenburgh left for the East on May 15th to take up his duties in a more responsible position with the latter company at Chicago. Mr. Van Valkenburgh established himself in San Francisco a few days prior to the great disaster of 1906, just in time to undergo the test of fire that followed, and that he acquitted himself with credit in the complex work of reorganization is a matter of record. By his sterling honesty

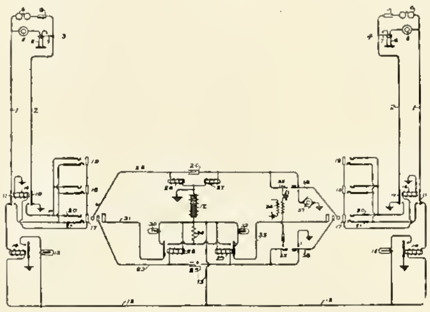
R. W. VAN VALKENBURGH.

and just methods he quickly made for himself a recognized position among credit men on the Pacific Coast generally. The great interest shown by him in the Electrical Trades Association and the time he devoted to the work of that organization resulted in his election to the vice-presidency, a position with which he was twice honored and which he occupied up to the time of his departure. The large circle of friends, both personal and business, formed during the brief two years he was with us join in congratulations on this well-merited recognition of his ability and best wishes for his future success.

PATENTS

THREE-WIRE CENTRAL-ENERGY TELEPHONE SYSTEM. 885,186. Charles A. Simpson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill.

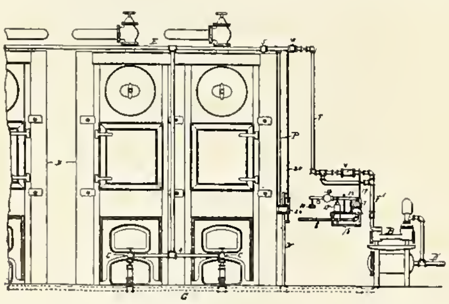
In a telephone system, the combination with a pair of telephone lines, of a cord circuit for making connection therewith for conversation, a third conductor at the central office isolated from the talking circuit, a cut-off relay in said conductor associated with the line, a supervisory signal in said conductor associated with the cord circuit, a pair of terminals in the talking circuit normally disconnected from the line at the contacts of said cut-off relay,



an impedance coil, a central source of current and a supervisory relay in a bridge of the cord circuit, a normally-open low-resistance branch circuit about said signal, and means operative in making connection with the line for completing the talking circuit through said terminals at the contacts of said cut-off relay, said supervisory relay being energized over the telephone line and said impedance coil, and being adapted to open the circuit of said signal and close said low resistance branch when the subscriber's telephone is in use.

SYSTEM OF REGULATION FOR OIL-BURNING PLANTS. 886,466. James R. Atchison and Clarence R. Weymouth, San Francisco, Cal.

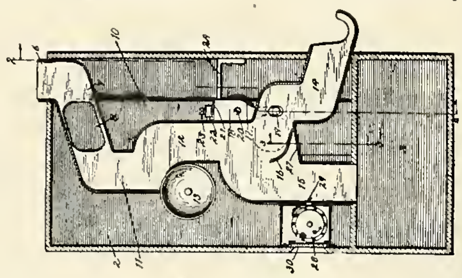
In a system of regulation for liquid fuel-burning plants, a liquid fuel burner adapted to receive a continuous flow of liquid fuel and a continuous flow of an atomizing agent, means for varying the supply pressure of said liquid fuel and thus the rate of flow of said fuel through



the burner, and means controlled by the variation of said liquid fuel pressure for automatically governing the supply pressure of said atomizing agent and thus the rate of flow of said atomizing agent through the burner and producing a continuous flow of said atomizing agent, the said governing being independent of a commingling action of said fuel and said atomizing agent.

SYSTEM AND APPARATUS FOR TELEPHONE LOCAL TOLL OR PAY STATIONS. 886,497. James Harrison, St. Louis, Mo.

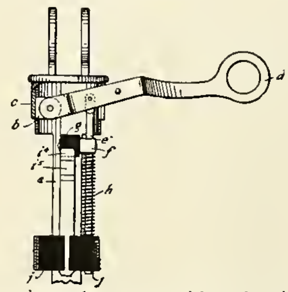
In a coin collecting or pay station for telephone systems, the combination with a supporting member in the line of movement of the coins for receiving the impact of the coins and to suspend the first coin in position to effect the deposit of succeeding coins into a suitable depository,



and means associated with the supporting member for holding the coin thereon and which when moved permits the suspended coin to pass from the supporting member and be refunded.

TELEPHONE-HOOK SWITCH. 885,348. Herbert L. Knight, Cleveland, Ohio, assignor, by mesne assignments, to Century Telephone Construction Company, Buffalo, N. Y.

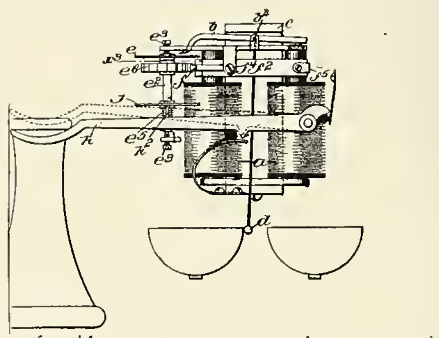
In a telephone hook switch of the class described, the combination with a tubular casing, of a telephone-support-



ing switch hook pivoted at one side of said casing, an ingangue over the side, in combination with a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, means for transmitting motion to the secondary shaft, an auxiliary shaft, and an independently adjustable arm connected therewith and with the table for imparting lateral motion to said table.

TELEPHONE SYSTEM. 885,270. Frank E. Mayberry, West Medford, and Newman H. Holland, Brookline, Mass., assignors to Boston Telephone Selector Company, Boston, Mass.

In a signaling system, an electro-magnet provided with a polarized armature and a signaling device operated by the vibration of said armature; means for preventing

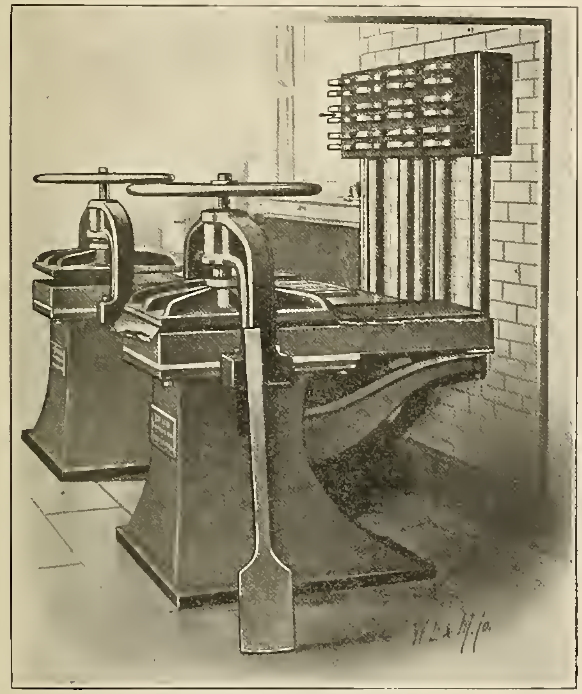


the vibration of said armature; a second armature in the field of said electro-magnet adapted by its movement to operate the means for preventing the vibration of the polarized armature; a third armature to control the restoring of the preventing means to normal; and means for energizing said electro-magnet by direct currents and by alternating currents.

INDUSTRIAL

ELECTRIC HEAT APPLIED TO STEREOTYPING.

A striking example of the advantages of electric heating over steam or gas heating is afforded by the Hadaway electrically-heated stereotypers' matrix drier. The stereotyping process in every newspaper office is one in which the time element is of the greatest importance. Every minute counts and much experimenting at great expense has been undertaken for the sake of reducing the time. With the other methods developed to the utmost, the electric method shows a saving in time of from fifty to sixty per cent.



STEREOTYPERS MATRIX DRIERS.

In addition to the saving in time, the Hadaway matrix drier presents a number of advantages over the older types. The bed which contains the heating element is solid and has no tendency to give like the cored bed required by other methods. The liability of the bed to explode from excessive pressure is entirely eliminated. Electric heat can be more closely regulated and is absolutely reliable.

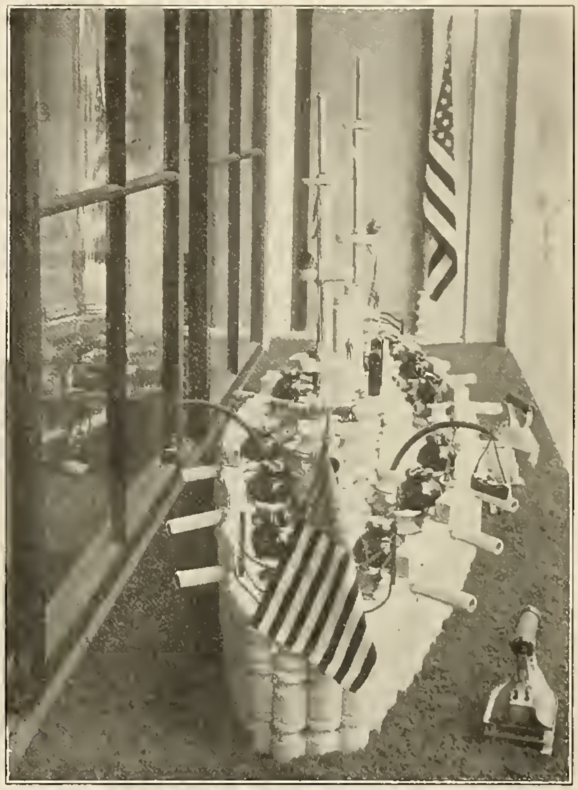
The heating element consists of a steel resistance grid, embedded and hermetically sealed in fireproof insulation in a heavy bed plate, immediately below its upper surface. As the result of this construction the surface of the bed plate attains a very high temperature and the solid metal below serves as a thermal storage reservoir. The cold form draws the heat very rapidly from this surface, so that the type is very quickly brought to the temperature required to thoroughly dry out the matrix.

The grid is practically indestructible. The fireproof insulation does not deteriorate when continually subjected to high temperatures. It has a high dielectric strength and good heat-transmitting qualities.

This device is manufactured by the Westinghouse Electric & Manufacturing Company.

BROOKS-FOLLIS PORCELAIN BATTLESHIP.

With the coming of the fleet and the resultant crowds the various San Francisco electrical supply firms prepared attractive window displays. Flags and ribbons waved to the wind of electric fans and variegated electric lights twinkled a warm welcome. But the picture on this page shows a vessel attached to neither the Atlantic nor Pacific fleet. It appeared in the window of the Brooks-Follis Co. and is constructed entirely of porcelain insulators. Close examination will reveal the ingenuity and patience necessary to assemble the parts. Incidentally it attracted much favorable attention to the various other lines of electrical supplies carried at the new store of the Brooks-Follis Co. at 44-46 Second Street, San Francisco.



PORCELAIN BATTLESHIP.

LUMINOUS ELECTRIC RADIATORS.

Luminous radiators consist of an ornamental cast-iron frame, fitted with a polished copper reflector at the back and with three or more large cylindrical incandescent heating lamps, and are described in an attractive pamphlet recently issued by the General Electric Company, Schenectady, N. Y. The source of heat is a small filament which becomes incandescent immediately, emitting a powerful heat from the moment the current is turned on, and as it radiates the heat directly it does not depend for its operation on setting up a current of warm air. The luminous radiator is thus distinguished from all other electric heaters which take an appreciable length of time to become effective. The pamphlet describes the uses and advantages of the apparatus and shows many illustrations of installations. It is of interest to all electric companies who wish to increase their revenue without additional distribution expense, as well as to architects and house owners.

A NEW FLAME ARC LAMP.

There has just been placed on the market by the General Electric Company a new flame arc lamp. The external appearance of this lamp is similar to the G. I. enclosed lamp, the casing being drawn seamless from either sheet copper or steel. The standard finish for the copper casing is "antique," and "bright japan" for the steel. This lamp has no chain feed or complicated escapement and clock mechanism. It is of the inclined carbon type, with nothing below the arc to obstruct the light, and both carbons feed by gravity simultaneously, while the regulation of the arc is accomplished by the lateral movement of one carbon to the other. When the casing is lowered into the trimming position, every part of the lamp becomes accessible.

A serviceable "economizer" of refractory material surrounds the points of the carbon just above the arc, so as to prevent the "washing" of the carbon ends, and to steady the arc from the effect of air currents so far as possible. A "blow magnet" is so situated with relation to the arc that it performs the double function of keeping the arc steadily fan-shaped at the carbon tips, and also totally extinguishes the arc if for

any reason it approaches dangerously near to the "economizer." The "economizer," therefore, is well protected from burn out and should last indefinitely. A heavy "baffle plate" of insulating material is provided just above the "economizer," effectually preventing any appreciable amount of the products of the arc from depositing on the parts of the mechanism. During operation the lower surface of the bottom plate of the lamp and of the economizer becomes coated with white deposit from the arc, which acts as an excellent reflector for the upward light from the arc.

These lamps are designed to burn two-in-series or singly across 100 to 125 volt direct or alternating current circuits. They can be used on any frequency between 40 and 140 cycles. The lamps may be wound for either 8, 10, or 12 amperes, the latter current being considered standard. All lamps are equipped with light opal globes.

The life of these lamps is about twelve hours on indoor circuits and between 10 and 11 hours on outdoor circuits. The simple construction, remarkably high efficiency, and the volume of illumination obtained from these lamps appeal to the operators of mills, wharves, warehouses, erecting shops, foundries, and other places where the quantity of light is as desirable as the quality.

THE COST OF PREVENTING BOILER SCALE

Some time since Dr. Arthur D. Little, Chemist of Boston, was called upon by one of his clients controlling a considerable number of boiler plants, to study the conditions therein with a view of standardizing the methods of preventing boiler scale and reducing the expense therefor. Obviously his report cannot be made public in its complete form, but, devoid of specific references, the following general abstract will doubtless prove helpful to better owners and operators:

In seven mills Mr. Little found soda ash and kerosene in use, either alone or in combination with each other, while in three mills a fume compound was employed. The price of the latter was 10 cents per pound, its approximate composition being

Water	28%
Insoluble Matter	9%
Sodium Carbonate	43%
Sodium Phosphate	13%
Organic Matter (Tannin)	7%

Another mill was using a special compound costing only 2¾ cents per pound with an approximate composition of

Alkali	14%
Insoluble Matter	5%
Water and Organic Matter	81%

Still another mill was using a compound at 6 cents per pound composed of

Water	10%
Soda Ash	53%
Common Salt	33%
Organic Matter	4%

It was found that all the mills in the combination which used special compounds were expending nearly $1300 per year for boiler compounds. Those which were using only soda ash and kerosene were expending very much less per horse power although practically the same water supply was provided.

The method of applying the soda ash was investigated, and it was found that in the case of a number of mills there was a mistaken idea of the use of a boiler compound. The methods employed in these mills, while differing somewhat in details, were to add the soda ash once a week and *clean the boiler*. The true method was shown to be to add the soda ash in small quantity and continuously, and then keep the boiler in a condition so that by frequent blowing off it is *kept clean*.

It was shown by Mr. Little that a considerable saving could be made and a better result secured, not only by reducing the cost of the compounds themselves, but by keeping the boilers in first-class condition and preventing the formation of scale, thereby reducing the amount of coal required to produce the desired amount of steam.

H. W. JOHNS-MANVILLE CO. IN DETROIT.

The business interests of the H. W. Johns-Manville Co. in the city of Detroit and the territory adjacent thereto have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at 72 Jefferson Avenue, Detroit, under the management of Mr. Willard K. Bush. Mr. Bush is well and favorably known throughout that section of the country, having been connected with the Milwaukee branch of the company for a number of years. The company will carry a complete stock of goods at the Detroit branch, so that shipments can ordinarily be made direct from Detroit stock.

PALACE HOTEL WIRING.

John G. Sutton Co., 229 Minna Street, San Francisco, have been awarded the contract for wiring the Palace Hotel. This includes over 170,000 feet of conduit, panelboards, switches, receptacles for lighting, as well as the telephone and fire alarm systems. Including the extensive temporary installation, this work will cost about $60,000.

NEWS NOTES

TELEPHONES.

Seattle.—The petition of A. W. Davis for a telephone franchise at and near Rodondo Beach was granted.

Seattle.—The petition of B. B. Cox for telephone, electric light and water system in Loyal Heights. Hearing June 9th.

Miles City, Mont.—Construction on the Miles City telephone line, forty-four miles in length, will be commenced at once.

Salt Lake City, Utah.—The Tintic Mining Company, of Salt Lake, will install in some of their mines near Ogden, a complete mining telephone system.

Stinson, Ida.—The County Commissioners have granted a telephone franchise to the residents of this place to construct a telephone along the public highway near this vicinity.

Spokane.—The residents of Minto Park Addition have petitioned the Pacific States Telephone Company to install a telephone system. The company will consider the matter.

San Francisco.—The Board of Supervisors on May 18, by a tie vote, prevented the proposed ordinance for reduction in the existing telephone rates from passing to print.

Lewiston, Idaho.—It is expected that within the next sixty days work will begin in building a new telephone exchange to accommodate the Interstate Company, which is rapidly building toward Lewiston from Spokane.

Salem, Or.—M. W. Mahoney, President, and Alex Harold, Secretary, of the Salem-Fairfield Telephone Company, have filed a petition with the county court for permission to build a telephone line along the Salem-Champoeg road.

Vancouver, B. C.—Construction of the new trunk telephone line to connect the farming section of Dewdney municipality with the city of Vancouver has already begun and the line will run through Port Hammond and Port Haney, extending as far as Nicomen Island.

Wallace, Idaho.—Work has started on the construction of the new common-battery plant of the North Idaho Telephone Company at Wallace, Idaho. The switchboard will be of the lamp line signal, common battery multiple type with an ultimate capacity of 1,800 lines.

Newport, Wash.—R. S. Anderson, who was granted a franchise by this place recently, has reached the city. Mr. Anderson purchased the local exchange of the Pacific States Company. The system will be reconstructed, and the line extended to Metaline. About $10,000 will be expended.

Ilwaco, Wash.—W. H. DeVarney, general superintendent of the B. R. Electric and Telephone Manufacturing Co., of Portland, has secured the contract for putting in the new telephone line for the extension of the Ilwaco Railway Company from Ilwaco to Knappton, and will commence construction work as soon as material can be brought down.

Boise, Idaho.—It is reported that an independent telephone line is now being constructed from Elko, Nevada, to Mountain Home, and it is understood it will be extended from the latter place to Boise some time during 1908, which will give this city a direct line into the heart of Nevada. It is thought the exchange of the new system will be established here.

Sedro-Woolley, Wash.—The Skagit River Telephone and Telegraph Company has commenced the construction work on its line at Baker, and expects to complete it as soon as possible. It is intended to run the line from the Washington Portland Cement Company's plant through Baker, Superior, Hamilton and to this city, where it will connect with either the Sunset or Independent lines for long distance service.

Sumas, Wash.—A number of people of Upper Sumas, Abbotsford and Huntingdon met at the customs office of Fraser York, on the boundary line, and formed a telephone compay for Sumas and Matsqui municipalities. L. G. Van Valkenburg, local director for the Farmers' line in Whatcom County, assisted with the organization. It is the intention of the company to build lines in those municipalities where needed and connect with lines from Chilliwack and other municipalities to the west.

ILLUMINATION.

Fruitvale.—A. Hunse and others of this place are planning the erection of a gas plant which is to serve the suburban territory east as far as San Leandro.

San Francisco.—The engineer has been directed by the Board of Harbor Commissioners to prepare plans and specifications for an electric light plant on dredger No. 3.

Los Angeles.—The Loftus & Burnham Company, of Los Angeles, has acquired the townsite of Heber, on the Imperial Valley Branch of the Southern Pacific Railway, located midway between Calexico and El Centro. The company is making plans for an electric lighting system.

Beaumont.—The Beaumont Gas & Electric Company has signed a contract with the Western Boiler Works, of Los Angeles, for generators, shells, holders, and other apparatus for the Beaumont Gas Works. The Los Angeles Company was represented by Mr. Darby, who came to close the contract.

Woodland.—A. J. Munch, a Stockton contractor, has revived the speculation as to whether or not natural gas can be developed in sufficient quantity and at a cost to make the enterprise profitable. He compares conditions as to the fall of the country and the conditions of the soil with the country round about Sacramento and Stockton, and as they are similar, he expresses the confident opinion that there is an abundance of natural gas here, although he might have to go deeper than 2,000 feet to find it. He says that a 14-inch well would supply 50,000 cubic feet of gas every 24 hours, and that such a well could be sunk and all pipes laid for $15,000.

TELEPHONE.

John W. Fisher, general manager of the Interstate Telephone Company, Spokane, Wash., is acting as consulting engineer for the North Idaho Telephone Company, which has a number of exchanges under construction and in contemplation.

The Hermiston, Oregon, telephone plant was put in service last week. This system is a new departure in telephone exchange work, in that two, four, six, or eight telephones are placed at will on one line, and each telephone rings selectively, not disturbing the others. The patrons express themselves as being very much pleased with the service.

The contract for the new common-battery plant to be installed at Wallace, Idaho, by the North Idaho Telephone Company will be let within the next sixty days. The Stromberg-Carlson Company, the Dean Electric Company, and the American Electric Telephone Company will be the firms that will bid on furnishing the equipment.

Seattle.—The Board of County Commissioners granted a telephone franchise for Vashon and a portion of Maury Islands to H. Harrington, A. D. Cowen and J. W. Rickert, the life of the contract to extend fifty years. Permission was given by the Board to lay a suburban cable from a spot near Fauntleroy Cove to Dolphin Point, on Vashon Island, and thence along the beach from Dolphin Point. Permission is given to string wires and set poles in the county roads.

The Independent Long Distance Telephone Company, of Boise, Idaho, and the Interstate Telephone Company, of Spokane, are endeavoring to perfect arrangements for a through circuit for long distance between Spokane and Boise. A conference between the two companies will take place in Spokane this week to arrange the preliminaries. The Boise company now reaches as far north as Grangeville, and the Interstate company has a new line staked out as far south as Lewiston, where it has recently been granted a franchise for a local exchange.

San Francisco.—The telephone committee of the Board of Supervisors is about ready to report an ordinance fixing telephone rates. If the ordinance meets with the approval of the board, telephone charges and rentals in San Francisco will be reduced practically 10 per cent. The proposed reductions are not a flat cut, but in the aggregate it is figured that with the pruning to which the telephone company's schedule of charges has been subjected, the rates will still be large enough to return 6 per cent net on an investment of $6,000,000, at which figure the investigating committee has fixed for rate-fixing purposes the investment of the telephone company.

Callahan.—Those interested in incorporating the Callahan Telephone Company met here last week and formed a temporary association by electing F. A. Drant president and F. W. Armstrong secretary. A general discussion was had and plans submitted for incorporating the company and starting the construction of the line to Gazelle, a distance of 28 miles. All the residents along the public road between both points have signified their desire to have telephones in their residences, and this, in conjunction with the aid promised by the National Forest Service officials, assures the completion of the line at an early date.

The telephone operators at Boise, Idaho, employed by the Independent Long Distance Telephone Company, were the guests of the White Line Transfer Company the other night, and participated in an old-fashioned hay ride. The transfer company sent around a four-horse team with a big box on the wagon and plenty of hay. The line of march included the streets of the city, as well as a ride through the country. The "doings" included a plentiful supply of ice cream, other good things, and between times the rendering of a "telephone yell," which went like this:

"Who are? who are? who are we?
We're the telephone companee.
Independence is our boast.
Number, please? without a roast."

General Manager Charles J. Sinsel chaperoned the party and exerted himself to see that every one had an enjoyable time.

The telephone rates committee of the Board of Supervisors has submitted an ordinance so regulating the charges that may be made in this city and county during the coming fiscal year that the effect will be a general reduction of 10 per cent from the rates now charged. The proposed reduction in rates is to be effected partly by increasing the service to be given for charges left undisturbed, and partly by direct and in some instances radical cuts in other charges. One of the most important provisions in the new ordinance aside from the rates is that which allows telephone users maintaining private exchanges to select their own operators instead of compelling them, as may now be done under the existing form of contract, to employ such as the company may choose for them. This course is regarded as safeguarding the rights of girls who have fallen into disfavor with the company because of the recent strike, to obtain employment without regard to the wishes of the company. One of the direct reductions in charges ordered under the new ordinance cuts the ten-cent charge made for single switches at the ferry and other public exchanges to five cents. The other direct money reductions ordered under the new ordinance are as follows: For each trunk line connecting a private exchange with the company's exchange the rate, now $3.00, shall be reduced to $2.50. For one-party residence telephones, unlimited service, the present $5.00 rate is to be reduced to $4.00; two-party lines, $4.00 to $3.50. For each additional telephone connected with a private exchange and installed in the same premises, except in hotels, the monthly charge, now $1.00, shall be 50 cents. In hotels the extra charge is to remain as now, 25 cents a month. For each extension telephone on a residence or business line the maximum charge per month, now $1.00, shall be 50 cents. While the maximum charge for private line telephones remains $2.50 per mile per month, the rate for stations on such line is reduced from $1.00 to 50 cents. In making the reductions stated, the members of the Telephone Rates Committee have sought to so arrange the schedule that the company may obtain six per cent return on a total investment of $6,000,000, having, in figuring to this end, estimated that there will be a 20 per cent increase of business during the coming year, with a corresponding increase of but 7 per cent in expenses. The company's own estimate of its total investment is $6,496,596.

TRANSMISSION.

Eureka.—M. C. Hast, acting for the Crystal Water Company, has filed a notice of location of 15,000 inches of water in Jacoby Creek.

Turlock.—Notice has been given that T. J. Burrow, Jr., has applied for and will be granted a power line franchise in Stanislaus County.

Red Bluff.—Leon Bly has filed a notice to the effect that he has appropriated 10,000 inches of water in Mill Creek. The water is to be used for power purposes.

Groveland.—George Donaldson has filed claims to 60,000 inches of the water of the South Fork, to be diverted one-half above and one-half below the Hardin ranch.

San Jose.—The Tuolumne Water Company has petitioned for a franchise to erect towers, poles, masts, and other superstructures along the highways of Santa Clara County.

Fillmore.—C. J. Elliott, of the Ventura County Power Company, has announced that the company has completed arrangements for the extending of its line along Sepe Avenue to supply electricity for light and power purposes along that street.

Chico.—The $20,000 power plant of the Steifer Mining Company near Magalia has been completed after a year's construction work, and the pumping of water from the mine is now under way.

Marysville.—Warren Sexton, representing the Great Western Power Company, was the only bidder before the Board of Supervisors at its last meeting for the power line franchise that was advertised for sale. The bid was $225, and was accepted.

Sacramento.—The Board of Supervisors has granted to the Great Western Power Company a franchise for a period of 50 years, to erect and operate an electric power line in Sacramento County. The bid of the Great Western Power Company for the franchise was $100.

Santa Rosa.—The contract has been let for the carrying out of one of the largest electrical projects in Northern California, namely, the construction of a power line from the generating plant of the Snow Mountain Power & Water Company, on Eel River, Mendocino County, through Ukiah, Hopland, Cloverdale, Healdsburg, Windsor, Santa Rosa, and on to Petaluma. The line has already been built as far as Talmage, two miles from Ukiah, and the poles and wire are on the ground for carrying on the construction. It will be a big enterprise, and it is predicted that it will mean a big reduction in rates for power and light when the current is turned on.

Palo Cedro.—The Northern California Power Company has commenced construction on a 60,000-volt line from its sub-station at this place to Kennet, Cal. This additional line will give Kennet four different circuits. The new line will be cut in so as to give Redding the equivalent of another circuit, making four for that city also. At Kennet another sub-station will be constructed with a capacity of 7,000 horsepower. Because of the Mammoth mine and smelter, Kennet consumes ten times as much electric power as Redding. The new transmission line will be a feeder also for the electric-process iron smelter at Heroult. This line will have a capacity to transmit 20,000 horsepower and will be 16 miles in length.

INCORPORATIONS.

San Bernardino.—Articles of incorporation have been filed by the Chino District No. 1 Water Company and the West Chino Water Company.

Los Angeles.—The Northwest Oil Company has been incorporated by R. C. Gills, E. P. Clark, R. P. Sherman, S. J. Eginton, and M. E. Hammond. The capitalization of the company is $60,000.

San Francisco.—The Keystone Electric Company has been incorporated, with a capital stock of $10,000, by S. H. Foster, George Nolan, and Wm. W. Goldnamer. A. P. Harris, of San Francisco, is attorney.

San Francisco.—Articles of incorporation have been filed with the County Clerk by the Marin Gas Company. The capital stock of the company is $15.000, and the incorporators are R. P. Greer, F. B. Turpin, W. J. Tiffany, E. D. Peixotto, and Charles Tanzer. The place of business is San Francisco.

Riverside.—Articles of incorporation have been filed for the Whitewater Land & Power Company. The company is framed for the purpose of locating, developing, purchasing, and acquiring water rights. The capital stock of the company is $500,000. The directors are H. Edwin Moore, J. E. Cowles, Arthur E. Poole, of Los Angeles; John E. Coffin, of Whittier, and W. B. Scarbourough, of Monrovia.

ILLUMINATION.

Alameda.—The electricity commission has awarded the contract for a new boiler for the electric light plant to the Risdon Iron Works for $5,100. There were seven bids in all. The commission is also figuring on installing a heating and water plant to warm the water used by the turbine engine.

Sausalito.—The Town Trustees at their last meeting were petitioned to grant a franchise to lay gas pipes in the streets to supply consumers with gas for illumination and domestic purposes. Mr. Grimwood, a well-known gas engineer, is now looking up a site in Sausalito. Messrs. Blair Trupin of Mill Valley; Robert P. Geere and W. Z. Riffany, of Sausalito, are behind the proposition.

San Francisco.—The Permanent Downtown Association of merchants, property owners, and other business men in the triangular district bounded by Sutter, Powell, and Market Streets, has presented to the Board of Supervisors a plan for lighting the retail section of the down-town district. The association, through a competitive test among the leading architects, has secured a handsome design of pole, which will adorn the streets in the day time and furnish a brilliant light in the evening. The plan provides for 160 poles, averaging eight poles to long blocks and three to short blocks. The Board of Supervisors has accepted the plan, and the city will furnish the electric current for lighting.

WATERWORKS.

Gridley.—Engineer Beebee has presented a plan for a water system to cover the whole city at a cost of from $23,000 to $30,000.

Los Angeles.—The Water Commission is taking steps to extend the chief feeding water mains for the business section of the city.

Prescott, Ariz.—Frederick W. Smith has applied to the City Council of Williams for a 25-year franchise for the installation and operation of a city water system.

Glendora.—Sanders Bros. have been awarded the contract to lay the water mains and laterals for the Monte Vista tract, which is situated between Pomona and Ontario.

Vallejo.—At the last regular meeting of the Board of Public Works of this city, the secretary was authorized to advertise for bids for 3,060 feet of 4-inch iron pipe.

Fresno.—George Scane has been granted a franchise for 50 years by the Supervisors to establish a waterworks and distributing system for the town of Fowler.

Gridley.—Last Wednesday evening at the office of the City Attorney, R. C. Long, the City Board of Trustees held an informal conference with Engineer Ralph Beebee on the subject of a waterworks system.

Los Angeles.—The Board of Supervisors has passed an ordinance granting the Lawndale Water Company, a corporation, a franchise to construct and maintain a water system upon certain highways in the County of Los Angeles.

San Dimas.—The Board of Directors of Artesian Belt and the San Dimas Irrigation Company have authorized the installation of a steel pipe system extending from the Base Line plant to the top of the bluff over the town, near Artesia Street.

Washington.—Secretary of the Interior Garfield, after seeing the President, rendered his decision to give the people of San Francisco a chance to vote on the question whether or not they want reservoir rights at Lake Eleanor and Hetch-Hetchy.

Madera.—Chairman Trede, of the Board of Trustees, wishing to have the matter of the estimates of a water and sewer system for the city revived, has appointed City Surveyor Smith, Trustees Wagner and Thurman as a committee to look into the matter of cost.

Salt Lake City, Utah.—The Telluride Realty Company, which owns Federal Heights, asked that the water main system be installed there at once, and agreed to put up a certified check for $14,002.23 for the estimated cost. The matter was sent to the waterworks committee for consideration as to details.

Coalinga.—The Pleasant Valley Water Company expects to commence work laying lines from the town to the property of the West Coalinga Oil Company as soon as pipe can be procured. The directors of this company are now in communication with parties who have suitable pipe, and are making every effort to get the work started at an early date.

San Bernardino.—Property owners of Eleventh Street, between C and D Streets, will have the advantages of city water. At the last meeting of the Board of Water Commissioners a petition was filed and granted to lay a three-inch main along the street. The commission also granted a request from Councilman D. H. Wixom for an extension of the city water service in Meadow Brook Park, where some 700 feet of new mains will be laid.

OIL.

Richmond.—A. J. Timmons, manager of the Richmond Iron Foundry, at Outting Ferry Terminal, has taken in a large contract of oil-tank construction for the Associated Oil Company.

Yerington, Nev.—Col. W. G. Gregory, of Yerington, reports that he has discovered within 40 miles of Yerington good indications of oil, and that he has taken up several hundred acres of the land. It is stated that this land is on the oil belt recently discovered in Mono County, Cal., where wells are now being drilled.

Bakersfield.—A. Mills, of Clifton, Ariz., and B. Mills, superintendent of the Morenci Copper Mills at Morenci, Ariz., were here last week to inspect some oil lands about four miles south of McKittrick, which they own. They were taken out by C. E. Getchell, and it is learned that they will begin development work in a short time.

Los Angeles.—A combination oil land and real estate deal has just been made, wherein C. H. Hillman, a Seattle millionaire, becomes the owner of 5,000 acres of land near La Costa, 12 miles south of Oceanside. Mr. Hillman will bore for oil. Machinery costing between $25,000 and $30,000 is already on the ground, and the derricks are up. The operations will begin within a week upon three wells.

Los Angeles.—The Consolidated Petroleum Company has its well down 300 feet in the first oil well on the Wolfskill ranch in the western end of the Sherman district. There are several strings running on this property. President Gabel says he does not anticipate having to go below 1,500 feet, which is not as deep as most of the Amalgamated wells. On a lease on only 12 acres on the Schwoll ranch, just on the edge of the town of Sherman, a well has just spudded in. When the lease was being made, one of the owners demanded to know who was back of the enterprise or a heavy cash deposit. He was assured that it was the Standard. About the time this was done, Col. J. J. Carter, the Standard's highest authority on the Pacific Coast, was in the city.

TRANSPORTATION.

Los Angeles.—The Los Angeles Interurban Railway Company has been granted a franchise to operate upon a portion of Mountain Avenue.

Redlands.—After a heated debate both for and against the proposition, the Supervisors have decided to offer for sale the franchise asked for by the Redlands Central Railway Company of this city.

Tucson, Ariz.—Frank Adams, proprietor of Naco Hotel, in Naco, Ariz., reports that it is quite probable that eventually the car line which is at present in operation between Bisbee and Warren will be continued to Naco.

Oroville.—It is the report here that with the completion of the Oroville-Nelson cut-off the Southern Pacific Company will install a number of gasoline motor cars that will come into more direct competition with the Northern Electric Company's interurban system. The motor cars can serve all the towns now served by the electric road and many more, going further to the north and having the Marysville-Woodland branch to aid it.

TRANSPORTATION.

San Jose.—At the last meeting of the City Council an ordinance was passed granting L. E. Hanchett an extension of one year in which to complete and put in operation an electric street railroad on portions of First, Second, Third, Fifth, Eighth, West Virginia, Orchard, Goodyear, Keyes, and Washington Streets, provided that he shall co-operate with the city at any time street work is commenced on any of these thoroughfares.

Sacramento.—Judge J. B. Devine has petitioned the Board of Supervisors for a franchise for a street railway in and about Oak Park, Gould, and Carleton. Judge Devine said the application was made on behalf of W. T. Garrett and other capitalists of San Francisco. The proposed railway would be six miles in length and would afford accommodation to a present population of 7,500. Under the ordinance, which was read, it is proposed to construct a double-track trolley line, to be operated by electricity or other motive power than steam.

San Francisco.—If the United Railroads will pay a monthly rental of $1,000, build a safety station on Market Street, at Front, and permit municipality-owned roads, or roads yet to be built, to operate cars on lower Market Street, the Supervisors will issue a permit for the company to operate the electric cars of the Sutter Street line from Sutter Street to the ferry. This was the decision reached by the Public Utilities Committee at its last meeting. The committee is composed of Supervisors Giannini, McLeran, and Murphy, though there were present at the meeting Supervisors Payot, McAllister, Bancroft, Johnston, Murdock, and Comte. President Boeckman, of the Sutter Street line, was in attendance at the meeting, and when the ultimatum was reached he announced that it would be useless to present it, as it would not be accepted. The question of the Sutter Street line came up indirectly, as the result of a proposition made to grant the company a franchise to lay down tracks and operate an overhead electric line from Third and Townsend Streets to the mail docks, a distance of three blocks. Supervisor McAllister had undertaken to get this line constructed, and to that end had waited upon the United Railroads people. The Supervisors present were much opposed to legalizing the Sutter Street cars operating on lower Market Street unless the city got more out of it than three blocks of electric line to reach the mail docks, the permit for which the committee expressed its willingness to grant at any time the company desired it.

FINANCIAL.

San Francisco.—The Big Pine Surplus Water Storage Company has made an assessment of 25 cents per share, delinquent May 9th, sale day June 1st.

San Francisco.—Assessment of one-half cent per share, delinquent May 20th, sale day June 12th, has been made on the stock of the Encinal Oil Company. W. J. Nimmo is secretary.

Orange.—At the last meeting of the Board of Trustees, a petition was presented, headed by J. P. Small and Robert Hays and signed by 138 names, asking that an election be called to vote $40,000 bonds to purchase a gas plant.

Los Angeles.—Although new, the City Gas Company has a working capital of a few thousand less than $1,000,000. More money is needed to carry on the plans of the management and more bonds will be issued. The stock is held by 57 individuals at present.

San Francisco.—The comparative statement of the earnings of the Petaluma & Santa Rosa Railway Company for the month of March of last year and this year is as follows: Gross earnings, 1907, $13,782.41; for 1908, $16,274.41. Operating expenses 1907, $12,086.01; for 1908, $14,139.30. Net earnings for 1907, $1,696.40; for 1908, $2,135.11.

San Francisco.—The comparative statement of the Edison Electric Company's earnings for March are as follows: Gross earnings for 1907, $160,713.98; for 1908, $193,442.30. Operating expenses for 1907, $80,934.13; for 1908, $118,366.72. Net earnings for 1907, $79,779.85; for 1908, $75,075.58. Fixed charges for 1907, $47,377.91; for 1908, $50,169.26. Surplus for 1907, $32,401.94; for 1908, $24,906.32.

New York.—The annual report of the United Railroads Investment Company shows a decrease in the net income of $320,000, and about met expectations. The profit and loss surplus of $824,900 is equal to over 5 per cent on preferred stock. Referring to the effect of the strike, etc., President Thalman says that existing conditions in San Francisco justify the belief that the future prosperity of the city is assured, in which the United Railroads will fully participate.

INCORPORATIONS.

San Francisco.—The Foxall Oil Company has been incorporated, with a capital stock of $500,000, by Jos. Seeley, A. L. Weil, and E. B. Davis.

Eureka.—A. Waldner, M. C. Hast, W. C. Elsemore, J. Hamner, T. H. Chope, and E. G. Kramer have incorporated the Crystal Water Company at Eureka, with a capital stock of $500,000.

Bakersfield.—Articles of incorporation have been filed by the Arcturiss Oil Company, with a capitalization of $400,000, by Fred Phillips, W. C. Price, J. D. Wood, C. O. Morgan, and W. E. Mitchell.

Bakersfield.—The Salt Lake Oil Company, with a capital stock of $500,000, has been incorporated. The incorporators are J. D. Wood, J. E. Bamberger, Fred Phillips, W. C. Price, and C. O. Morgan.

San Francisco.—The National Electric Device Company has been incorporated with a capital stock of $50,000 by B. L. York, E. P. Norwood, and C. M. Boyd. The place of business is San Francisco.

San Francisco.—The Weidenthal-Gosliner Electric Works has been incorporated, with a capital stock of $100,000, by S. H. Weidenthal, Herbert Gosliner, and S. M. Samter. The place of business is San Francisco.

San Bernardino.—The San Bernardino Valley Telephone Company, of Ontario, has been incorporated, with a capital stock of $200,000, by J. A. Fletcher, J. N. Hartley, R. L. Dunbar, and R. P. Carder, all of Ontario.

Martinez.—Articles of incorporation have been filed by the Carquinez Electric & Construction Company, with a capital stock of $20,000. The directors are E. W. Jensen, Jos. Mayo, C. L. Pingree, F. C. Woolcott, and M. C. Arnold.

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Electric Grinders
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Western Electric Co.

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Standard Electrical Works.
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Goeriz & Co., O. C.
Moore, Chas. C. Co., Inc.
Pelton Water Wheel Co.
Standard Electrical Works.
Tracy Engineering Co.

Injectors
Vulcan Iron Works

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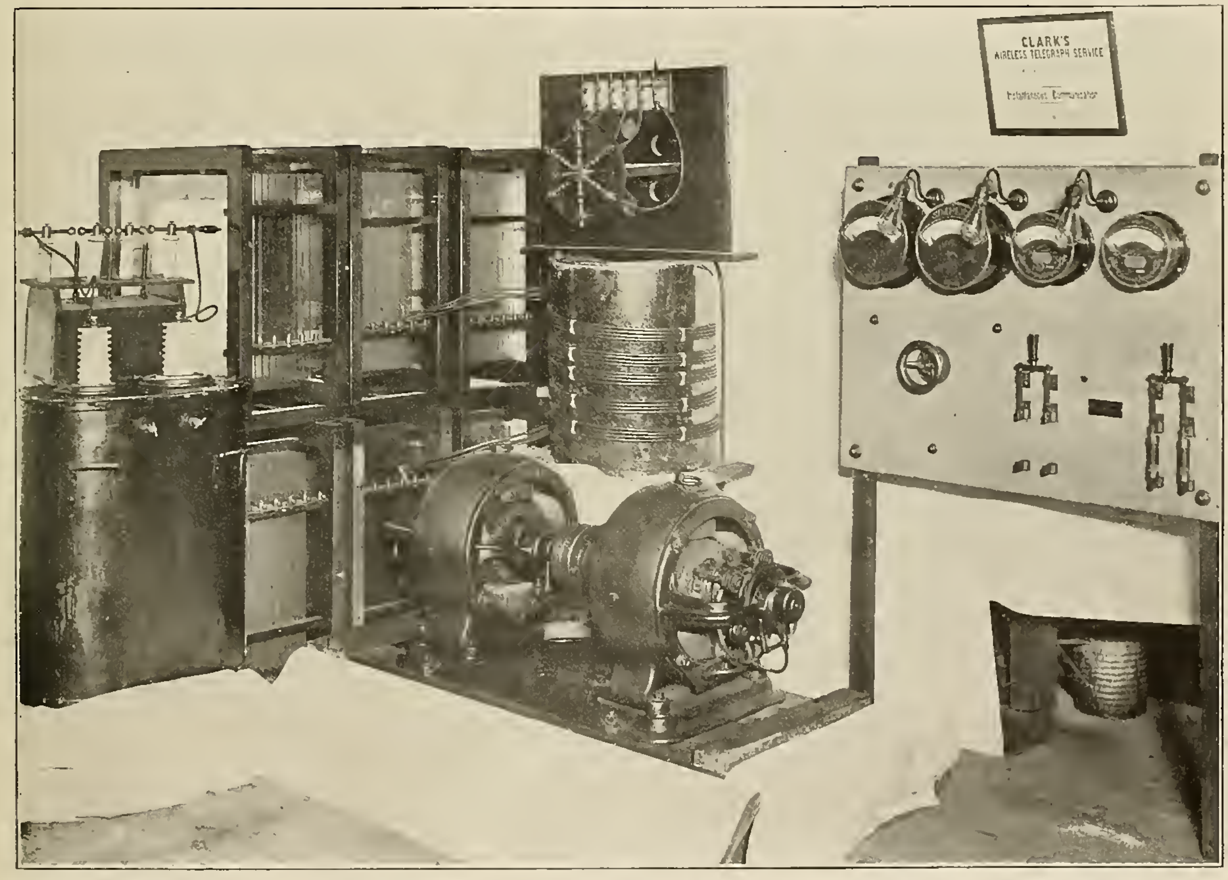
THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 30, 1908 No. 22

WIRELESS TELEGRAPH STATION AT THE SOO.

The electric equipment of the new wireless telegraph at the Soo, on the Great Lakes, includes a self-sustained ship's spar, 225 feet high, supported by four anchors of concrete cement of 12 tons each. This mast is guyed with four sets of ½-inch cables with four circuit breakers at each section, making 16 guys on the mast. The aerial capacity consists of 50 strands of special bronze wire, No. 6, B. & S. gauge stranded. These 50 strands are supported by a yoke yard-arm spread out 22 feet at the top. Each aerial wire is 450 feet long, terminating at the station multiple spark gap into groups of five wires each.



INTERIOR OF WIRELESS TELEGRAPH STATION AT THE SOO.

It is maintained that during the past season the Clark wireless system demonstrated to the marine interests of the Great Lakes the rapidity, accuracy and absolute reliability of the wireless telegraph service. It is held that with the opening of the Soo station this season another great stride will have been made towards the further usefulness of the wireless telegraph system in connection with the marine interests on the Great Lakes.

It is claimed that the Soo station will be one of the most complete wireless telegraph stations to be found anywhere in the world, and among the instruments and apparatus are devices which have not yet been introduced anywhere else. The station is manned by three operators—a chief operator and two subordinates. It is intended to divide the tricks into a nautical fashion of eight hours each. The most important part of the twenty-four hours will be in charge of the chief operator.

The electric equipment of the Soo station is 25 kilowatt capacity, and the electrical current and power to supply the transmitting generator set is taken from the water power company's mains at the Soo and brought into the station at a pressure of 500 volts. This connects direct to the controlling switch-board. From here the connections are led to the various parts of the controlling apparatus, which includes automatic motor, starter, voltmeters and ammeters and field control to regulate the speed of the generator set, all mounted on a polished marble switch-board. On the switch-board is also mounted the frequency indicators, including reactance regulators and automatic starter, so that the operator can control immediately at his right hand the full manipulation

of any part of the apparatus and tell by one glance at his recording instruments exactly what output and results he is obtaining from his apparatus and instruments.

It may be stated that the transmitting current enters the station at 500 volts, and is stepped up through 25-kilowatt oil insulated transformer to 80,000 volts. Shunted across the spark gap is the primary of the oscillating transformer connecting with 20 crates of oil insulator condensers. The top end of the secondary coil of the oscillating transformer being connected to the center terminal at the multiple aerial spark gap and the lower end or outer terminal of the oscillating transformer connects to the earth connection.

The latest receiving sets are provided for the receivers for the Soo station, considerable time having been devoted to the working out of a complete system of tuners which make this outfit a distinctive one, as it is not to be found on any other wireless telegraph station in the world, and it plays an important part in the accuracy and reliability of wireless communication. With this complete system of tuners, the Soo station will be able to get in communication with any other station or boats on the Great Lakes, and can also cut in or cut out any other station that would like to communicate with that station, no matter what the tune of these may be. In other words, the wireless tuner, installed at the Soo station, is arranged so that the operator can isolate and select the station with which he is desirous of communicating.

It is said that the tuner is arranged with a combination of inductance and capacity, by the adjustment of which the operator can inform himself of the various wave lengths of the different stations, and with the assistance of the tuner, the aerial wires of the receiving station can be made equal to that of a sending station, therefore, the receiving operator can tune up or tune down the scale of waves as the case may be, to get connection with any other station, or shut out other sending stations if he so desires.

A special design of head-telephones is provided for the operator, which are of the most sensitive type of work, in connection with the detector receiver circuit, and with the properly adjusted diaphragms the incoming impulses are rendered plainer and more audible to the receiving operator.

A system of interference coils are used to cut out the atmospheric static electricity, developed so as to isolate the station as much as possible, and, in fact, to have it as comparatively free from electrical interference as possible, which marks an important advance in the perfecting of the system for commercial work.

It was feared by many that the electrical impulses sent out by powerful stations would interfere with those of a feeble station, or of less power. It was also questioned whether interference could be rendered impossible or whether an operator could interfere with a competitor's messages.

It is claimed that the Clark wireless stations at Detroit, Port Huron, Buffalo, and Cleveland are in daily communication all day long, and at the same time there were a number of boats crossing Lake Erie carrying wireless apparatus, yet not a single message between these stations is readable on the steamers.

It is maintained that the problem of tuning and sychonizing has been practically solved, the receiving instruments are adjusted to respond to the frequencies of vibration and wave length of the other occupying a definite period, and all other waves than those for which the instruments are tuned are screened out. This may be illustrated by the action of the tuning forks by arranging the two tuning forks of the same sized tone, and pitched near each other. By striking No. 1 fork, tuning fork No. 2 is affected through the medium of the air, and responds audibly. This is what we call sympathetic resonance. But let No. 3 tuning fork, of a larger size than one in symphony with it be made to vibrate, whatever its proximity to No. 2, there will be no sound, for the radiator sending out the waves and the resonator receiving the waves must be equal in tune, or resonance will be impossible.

It is interesting to note that in the arrangement of the transmitting apparatus for ordinary messages, the Soo station is supplied with a special set of apparatus for communicating to a distance of 100 miles. When needed, the large power is brought into play, the high power apparatus having a maximum communication distance of from 500 to 1,000 miles, varying in wave lengths from 500 to 3,000 meters.

It is held that during the season of 1908, on the inland seas, messages will be sent direct into Cleveland, Buffalo, Detroit, Duluth, Chicago or Milwaukee from the Soo as easily as the Port Huron station sends messages into Cleveland or Buffalo. The value of the service can readily be seen, as the master of a boat can report on coming into locks or canal, and have a reply from the owner or manager before he is through the locks. This service cannot be rendered by the wire lines. The rapidity of the wireless telegraph service is without parallel. The wireless service on the Great Lakes is becoming indispensable to the vast shipping interests, and great success is assured with the present complete facilities and increased numbers of wireless stations now in operation.

COPPER MARKET SITUATION.

Copper is firmer and more active. Within the past few days there has been an increasing degree of strength manifest, and quotations for Electrolytic Wire Bars have advanced from 12⅜@12½ to 13 cents. Leading holders sold heavily during the last half of February for export at low prices, and since that time there has been considerable inquiry for domestic account with limited sales.

Europe has managed to maintain the most prominent position among the buyers of copper, and by securing important concessions the purchases by foreign interests have been in large volume. These transactions have relieved sellers here of great quantities of the metal, and as a matter of course domestic consumers are now confronted with much firmer conditions than was the case a few weeks ago.

There is some improvement in consumptive activity also, but although this is so, manufacturers are still intent on pursuing strictly conservative methods. It is encouraging, however, to note the gradual elimination of depressing conditions from business generally, and to see signs of well-directed efforts to re-establish normal conditions again in the industrial situation.

It is impossible to estimate just how long Europe will take to absorb the enormous exports from this country, amounting to over 168,000 tons since October 1. The resumption of production at the Amalgamated mines and the starting of operations at the Washoe smelter are factors of the first importance to the consumer. It will take an astonishing growth in consumption to prevent accumulation, and in the face of self-apparent facts it would be wise policy to encourage demand to the utmost by keeping the market on a reasonable basis. Inquiries from the American trade are more plentiful, and business has been closed at 13 cents with European buyers. Electrolytic has been advanced to 13 cents, and the market is stronger than for a considerable time.—"Copper Gossip."

DISCUSSION.

INDUCTIVE INTERFERENCE WITH TELEPHONE CIRCUITS IN PROXIMITY TO HIGH POTENTIAL TRANSMISSION LINES*

Mr. Hunt—Gentlemen, I am sure that we all appreciate very fully the paper which Mr. Miller has given us. A great many of us have experienced a great deal of trouble in the operation of telephone service of our own upon transmission lines, the wires being carried upon the same poles. Whether there are many of us who can discuss this matter as carefully as Mr. Miller, I doubt, but we have with us this evening a gentleman who is probably fully as competent to discuss it as any one in the country, and I would like to ask Mr. McMeen if he will come to the front and help us out a bit. I am very glad, Mr. McMeen, that you are able to be with us.

MR. S. G. McMEEN.

Mr. Miller's paper has appealed to me as being a timely and most important contribution to our knowledge. The problem which he discusses is one of the two late additions to the physical burden placed upon telephone enterprises. It is to be hoped that the fullest opportunity will be given for engineers to study the situation as Mr. Miller has presented it, and I can see no reason why his contribution is not most worthy of being given its place in the records of the Institute.

So small a part of the power resources of the country have been developed that we must expect an enormous increase in the amount of electrical power transmission. There seems to be no reason why we may not expect the transmission of very much more power than that available in waters. The utilization of fuels must be expected to call for additional electrical transmission. With a continued growth in population we must expect more and more of the highways to be occupied by long distance transmission and telephone lines; so that even if the difficulty of which Mr. Miller writes shall become intrinsically no greater, we must expect a very great increase in the amount of disturbance requiring to be prevented.

I would wish to emphasize as strongly as possible the feature with which the paper is opened. I refer to the financial burden which has been laid on the telephone business by almost every change which has taken place in other electrical organizations. If you will recall the phases through which telephony has passed, you will see that they have been many and distinct, and that some of the most radical and costly would not have been required at the time and in the degree they were, except for the appearance of new features in electrical power generation and transmission.

I emphasize this point particularly because it seems to me that the telephone business is unique in those unfortunate experiences. I do not mean that other arts, in their earlier stages, have not made frequent and radical changes; but I have been able to think of none in which so many changes were required—or at least precipitated—by some change in another not very closely related art.

Such hope as we have had for the future has been based on a feeling that telephony is approaching a condition when it may be considered immune to outside influences. Many conservative engineers have recorded such a belief. Do you now think it has been warranted?

You will remember that the earlier telephone systems all were operated over lines of a single wire each, using the earth as a return; that most of the circuits were in open wire, and that the introduction of the single-trolley, earth-return traction systems made local telephone systems almost wholly inoperative. You will recall the open-wire, single-conductor telephone systems were supplanted by metallic circuit cable systems, with interconnection between cities through metallic circuits of open wire, carefully balanced and frequently transposed. On this basis, every large system in the United States has been rebuilt, to conform with that standard of practice.

By a mere change of method on the part of transmission line operators, a very large and successful working telephone property suddenly is made less useful. And in some other parts of the country single-phase alternating current trolley systems are interfering even with long distance lines which have been placed underground throughout their length. There is no possible doubt that a long distance telephone cable laid in a conduit system and provided with a system of loading coils represents the most costly and refined method of serving its purpose which the art has produced so far. If, then, it is no longer possible to connect two cities by means of long distance lines either in the air or in the earth, without the hazard of having the circuits disturbed by other electrical systems, one is caused to wonder what course remains to be followed.

I see that these difficulties do not appeal to you as being as desperate as I am trying to show them to be, and it occurs to me that this may be because the interests of most of you lie in other directions. Nevertheless, it is most certain that one of the things which is needed is a great deal more just such discussion as this, so that we will at least understand each other's problems, whether or not we may really co-operate in solving them.

RUDOLPH W. VAN NORDEN.

Having been asked in a general way to discuss the operation of telephone lines in connection with long distance transmission circuits, I will treat the subject, briefly, as a review of some of the practical difficulties experienced in operation, rather than from a purely technical point of construction or design.

When the long distance transmission of power was in its infancy, ten to twelve years ago, the operation of telephone lines in connection with the transmission systems, although easily seen to be absolutely necessary and essential, was given little consideration, it being taken as a foregone conclusion that good standard apparatus and reasonably well maintained lines would give the required service.

The difficulties of operating the telephone system were increased with the adoption of higher voltages, and it has been necessary from time to time to devise methods for overcoming unlooked-for phenomena encountered in close proximity with high tension circuits.

By no means the least of the difficulties, however, can be laid to high voltage, and these are the sort that will occur on the medium voltage lines, as well as the most modern installations. I refer to the ordinary shortcomings of the simple bridging telephone system, which are overlooked and taken as a matter of coures, unless by persons of nervous temperament, who take the privilege of expressing themselves volubly to an inanimate transmitter. These ordinary shortcomings do not interfere with the power transmitting efficiency of a system so long as they permit intelligent conversation and there are no transmission troubles to contend with at the time. It is at the critical moment of some accident or interruption, when seconds count, and the perfect working of the telephone is imperative. It is at just this time that the petty annoyances are magnified, and in all probability, the cause of trouble to the power system will be a cause of trouble or interruption to the telephone.

It is, therefore, very necessary, in designing the transmission system, not to consider the telephone as an afterthought, to be installed in any convenient manner, but as a very essential part of the system, to be designed and carried out with the same care that the other component parts have been worked out.

*Paper read before San Francisco Section, American Institute Electrical Engineers, April 18, 1908.

The greatest fault that most power companies have committed in underestimating the importance of the telephone, is, building it too cheaply. The saving of a few minutes or even seconds' time by its proper working, at a critical moment, may often save the cost of enough damage to pay for several good systems.

The use of copper or aluminum instead of iron lines, of well insulated high grade instruments, properly mounted with carefully selected bells and ringers, and fuses and cutout devices, especially designed for the service, careful placing on the pole line (if it must be on the same line), on proper insulators and arrangements so that the patrolman will have no difficulty in communication at any and all times, are all of essential importance, and should be carefully considered, as on them depends the safe and satisfactory working of the system.

Electrostatic disturbances from the transmission system are often curious and annoying, when all apparent precautions have been taken to eliminate them. The writer has found that the most satisfactory service can be given when the telephone line is transposed at equal intervals so as to make an even number between switching points on the transmission.

As great a distance as is possible, between the transmission lines and telephone lines is advisable, aside from the prevention of actual contact, to minimize the disturbance in case of grounding or breaking or otherwise unbalancing the transmission system. It is, however, often impossible in such a case to prevent a disturbance which will make intelligent conversation out of the question. As before stated, at such a time communication is indispensable, and a carefully worked-out system of procedure should be followed by operators at the stations, especially if there are several points of power supply and delivery connected with the system affected. The writer has found this to work very satisfactorily, using a set of simple rules, thoroughly understood and put in practice by an occasional drill.

Line disturbances are sometimes so severe as to destroy apparatus and endanger the lives of operators. The writer at one time had a set of telephone instruments constructed by one of the leading telephone manufacturers, to operate on a particular system. These instruments were of the highest grade, with extra powerful ringer magnetos and loud bells. The wire of the magnet coils of the bells was much more heavily insulated than in ordinary practice. The induction coils were equipped with a tertiary winding for the receiver circuit, the whole coil being heavily insulated and contained within a receptacle filled with oil. The tertiary circuit, being practically closed, rendered the coil almost inoperative, and was cut out. The instruments otherwise, while possibly more proof against burnouts, were about as effective as ordinary standard instruments.

The best protection from lightning, direct contact with a high tension circuit or from heavy electrostatic discharges, seems to consist of fine wire fuses, two to three feet long, which will blow out before serious damage can result to the instrument. These fuses have generally been home made and various modifications entailing tell-tale devices are in fairly successful operation.

The question of insulation is an important one. A leak even if of very high resistance, will cause an unbalancing which may easily put the system out of service. Thus, care must be not only practiced on the line, but within the stations, and too great care cannot be exercised in mounting the instruments, bells and fuses.

The telephone manufacturing companies have developed standard apparatus to a point of good efficiency, but the specialization for transmission work seems to have been sadly neglected. Furthermore, in the requirements necessary, they seem to be much at sea. This is particularly so with that part of the equipment which the patrolman must handle.

A study of the methods of the persons who are to use the instruments and of the manner in which they are likely to use them is of importance.

Especially thoughtless, often, is the designer or operator in his consideration of the patrolman on whom much dependence is placed. Few people, not having actually observed him, have the slightest conception of the difficulties and hardships which he has to contend with, especially in mountainous districts. The importance of his work is often only magnified to those who are in a position to criticise him if he does not perform his duties promptly and efficiently, but the effect of inefficient, unsatisfactory and dangerous telephone instruments, in the discouraging effect on the temper and frailty of human nature, is seldom given a fair hearing.

There are several methods in vogue for his communication. He may carry a portable instrument which can be bridged on the line, by climbing a pole to the line, or wires may be brought down the pole, permanently, to within reach of the ground, and to which he may connect upon standing on an insulated platform. An instrument may be located at intervals of every mile or so, ordinarily cut out from the circuit and protected within a wooden box. The first and second of these methods would probably be preferable if a satisfactory portable instrument could be had. The writer has never seen one that was not too bulky and heavy, although many of them, each guaranteed to be perfection, have been tried and used. If reasonable care could be used in transporting the instrument and in handling it, many of the portables would be satisfactory; that seems to be, however, out of the question. The instrument must be light and easily attached in a hurry; it will be alternately soaked with rain and then left in the sun, and will always have any amount of jolting. During the summer, exposed rubber parts will oftentimes become so soft and plastic as to render that part useless, and the batteries which are generally hard to get, deteriorate rapidly.

Where stations are used, even if well protected and maintained in good condition, they must be several miles apart. The patrolman is usually alone, he may find a break of some kind that he can repair, or possibly one that must be quickly attended to. The getting to a telephone station, it may be, over a difficult hill or through a storm, may occupy very valuable time, and the strength and endurance expended thereon may greatly impair his work, and unless he be a very conscientious man, may give him good cause to slight his work.

Another point which has been pretty thoroughly overlooked is the satisfactory ringing of bells. All powerhouses have more or less noise, generally a great deal. While not always disagreeable, and often easy to get accustomed to, it very effectually drowns out many other sounds, and by the fact of the operator's getting used to it, he will fail to notice other sounds which he really hears. This is true with telephone signals. If now, as is often the case, the bell, while loud enough for a quiet room, has really very little power, the chances are (unless there is a special telephone operator), that the man on duty will pay no attention to it if he hears it at all.

To remedy this trouble, the first thought is for a good strong extension bell. This may be bridged directly on the line, or it may be operated by a local battery current or other source, contact being made through an annunciator drop. Both methods are unsatisfactory. When the bell is connected directly to the line, it generally means another coil across the line at that point, which probably has already as many as it should. If, as in many cases, the line has a fairly high resistance, the bell will not respond to a feeble ring, as, for instance, when the patrolman calls in. If an annunciator is used, we have the same defect, although possibly to a lesser degree; in addition, the drop is uncertain, due to the great variation in the strength of the ringing current. Again, if the drop is used, the auxiliary bell will ring continuously without giving the attendant any knowledge of what the call may be, and generally necessitating a useless trip to the instrument. In either of these cases, a heavy electrostatic disturbance may ring the bell.

A method which the writer has used with much success consists of a simple make and break apparatus to operate an auxiliary bell. This make and break has a very light "L" shaped strip of flat copper, pivoted at its angle, one end slotted and slipped over the vibrator of the bell, the other end bent down so as to dip into a small iron cup containing mercury. A drop of oil is added so as to float and form a thin film over the mercury. The slightest movement of the ringer, even if not sufficient to make the bell sound, will cause the arm of the "L" shaped piece to dip into the mercury, vibrating with the ringer, thus alternately closing and opening a local circuit. The bell which may be as loud as desired, can be located at any convenient place, and if of low resistance, can have mounted with it in series, a 32-candlepower lamp, the whole taking current from an exciter or lighting circuit.

Devices for the safety of persons using the instruments must, of course, come in for full consideration. These are simple and easily provided for, although history of the last few years has furnished accounts of distressing and curious accidents when all apparent precaution had been maintained.

MR. G. H. BRAGG.

Mr. Chairman and Gentlemen: Nobody realizes more than the transmission man, how fine it would be to have a telephone line, which would not be affected by power lines when the power lines are in trouble; and as Mr. Van Orden states, it is usually the case that, when we need the telephone line most, it is out of order, due to the influence of the power lines.

It might be of interest to some to hear of the success we Orden states, it is usually the caste that, when we need the the power wires. For all distances up to 100 miles, we find no trouble whatever in talking when conditions on the power lines are normal. The telephone wires are usually of copper or aluminum, and are on an average of eight or ten feet from the power wires. As stated already, these are rendered useless when the power wires become grounded.

Referring to the troubles of the telephone companies caused by power wires paralleling them for any distance, I am inclined to think that a good deal of it could be eliminated if the telephone lines were kept absolutely clear of trees and grounds. I recall instances wherein the telephone company has complained that certain ones of their leads were being influenced by our power wires in spite of the fact that load conditions were in balance. We could do nothing, of course, and after a time would learn that the telephone line was O. K. again, and a little tree trimming was the remedy.

Another source of trouble on the telephone lines exists, I think, in the weakness of the insulation in certain parts of the telephone system, as for instance, the small size of insulator used on the line, and the thin insulation on the wires at the exchanges. On all of our telephone work we insulate sufficiently to take care of a 10,000-volt system, and in this fact, as much as in any other, it is my opinion that the success of our telephone systems is obtained.

Of course, the insulation used by the telephone company is quite sufficient to take care of the e. m. f. produced by their ringers and talking batteries, but is not sufficient to take care of the electro-static effect produced by high voltage power transmission lines.

MR. WYNN MEREDITH.

Some means of communication between the power house and centers of distribution is a necessary feature of all electric transmission plants. The telephone has been used exclusively on account of its simplicity. Unfortunately, its extreme sensitiveness makes its use unsatisfactory or impossible at times when it is required the most, that is, when there are difficulties on the transmission circuit. There was a time in the early days of transmission when a quiet line was considered more of an accident than the result of careful and intelligent construction. Fortunately this time has passed, as with the proper spiraling of the transmission circuits and the transpositions on the telephone lines half way between the transpositions of transmission lines and a little juggling of telephone transpositions, a satisfactory and quiet telephone line can almost always be had, but only so long as the transmission circuit itself is in first-class condition.

In spite of the best planned and carefully located transpositions, a leaky insulator or ground on the transmission circuit puts the telephone system out of commission. At such time the transmission business must be carried on by a pre-arranged sequence of operations and regulation between the power house and the sub-stations until the trouble is removed and the telephone system made operative again.

To obviate this difficulty as far as possible, I have in many cases installed telegraph instruments in conjunction with the telephones, and had the operators become experienced in the use of the key, sufficiently to transmit the necessary communications for satisfactory operation of the power line. When the telephone has become inoperative, a pre-arranged sequence of trial circuits for the telegraph instrument has never failed to result in establishing a line of communication.

The next step would appear to be the use of printing telegraph. There are several satisfactory instruments in the market, and I believe that their use will insure a more continuous and uninterrupted service than the telephone, between terminal points. The telephone will probably have to be used for line repair work and such emergency service, but there is no reason why the printing telegraph should not be used in conjunction with the telephone, and in this connection it would have an additional advantage in that all orders given and received would be printed and records of the same maintained at both ends, thus obviating any question of a misunderstanding of orders.

Not the least of the difficulties attending telephone work in connection with high potential transmission lines is the danger to the operators from accidental contacts or leakage of current to the telephones from the transmission lines. Insulated stools and platforms are undoubtedly a great help and give considerable confidence, until one finally gets a considerable chunk of high potential juice, which sets one on one's back in the middle of the floor, watching the telephone burn up and drop piecemeal to the floor in fused masses; then one begins to think that something more is required.

I have equipped many moderate potential lines with a long enclosed fuse in the telephone circuit, the instrument end being separated from a ground connection by a film cut-out. This usually saves the instrument, and also the operator, but causes no end of trouble by letting go when switching of heavy currents is done, and at other times when it should not. Furthermore, it does not seem to be quite applicable to very high potential lines. Something of a more satisfactory protective character is evidently needed.

Mr. H. W. Crozier—In the matter of getting a quiet telephone line on transmission lines, some considerable work has been done by me, and after the construction work is completed, I have found it a good plan to cut in additional transpositions wherever a branch occurs from the disturbing source.

One case will illustrate. A telephone line was built on an electric railroad line which was paralleled for three miles by a 60,000-volt, two-circuit transmission line, and a 2,000-volt line. The telephone line of copper was regularly transposed every eighth pole, and when completed, was very noisy. After satisfying myself that it was clear of grounds, additional transpositions were cut in at the poles opposite where the high tension line approached and left the telephone line, and also opposite a transformer, making three additional transpositions. The telephone line was then quiet. There was no current on the electric railway circuits at the time. It was a simple case of balancing against a known disturbing element.

I have also found that grounds on a high tension line will make a very considerable disturbance, and particularly if the system extends over any considerable country. The Blue Lakes Co. operated a considerable mining circuit at 10,000 volts, there being no grounds on the system. Telephone lines of the Sunset Co. and of the Power Co. were carried on cross-arms on the same poles. An accidental ground on one of the 10,000-volt wires made the lines exceedingly noisy and made connections to ordinary ground return lines impossible at any exchange in the vicinity. A great deal of trouble was caused to everybody till the ground was located and cleared. While this trouble was on, the telegraph company was able to handle business as usual, but the operators could not adjust their instruments so that they would vibrate with the induced current in the telegraph lines. The telegraph line did not run as close as the telephone lines, but it paralleled the high tension lines for some 35 miles, and approached as close as 12 feet in places.

In the matter of using a printing telegraph, it seems that a fine place for this would be in the interurban electric railway field. Instead of sending orders by telephone to be copied by the receiving conductor on a manifolding machine in the telephone booth, it would be an excellent plan to use a printing telegraph machine. A combination of a Blake signal and a printing telegraph should make a fine dispatching system. All the conductor would have to do upon stopping for orders would be to send his signature and get the dispatcher's "complete." This is under the assumption that the printing telegraph would print a message which it would not be necessary to repeat. The Blake signals are operated by a single wire, and are not affected to any great extent by the high tension lines, and a printing telegraph should at least be as free from interference. It would be well to try out a printing telegraph on this kind of work.

MR. G. DEAKIN.

The discussion resulting form Mr. Miller's paper of tonight has brought out a number of very good suggestions regarding the operation of private telephone lines on power circuit poles. These suggestions, however, cannot be taken as applying with anything like equal force to commercial telephone lines, particularly toll lines, as operated by telephone companies. The reason for the existence of the two classes of telephone lines are entirely different. In the first case mentioned, the telephone circuit is of secondary importance, and is useful only as long as it facilitates the operation of the power transmission system. On the other hand, the lines of a telephone company exist in order that transmission they afford may be sold to the public, and, therefore, are of first importance, and are useful only as long as they are a source of revenue.

Closely connected with the subject of induction is the question of protection, since extreme cases of induction, due generally to the complete unbalancing of the paralleling power line, often put the adjacent telephone circuit in a very dangerous condition. From this view-point private lines on power poles differ decidedly from a commercial telephone line. A private line may be operated successfully with the induced potential of both sides of the line from ground materially above 350 volts; for this reason the protective systems which can be installed with safety on one class of lines may be entirely unsuited for the other. For example: open space cut-outs with thick mica separators operating from 800 to 1,000 volts such as must often be used on private lines on power poles could not for a moment be considered as affording satisfactory protection to a commercial telephone line, on which experience has shown that air gap protectors operating at approximately 350 volts must be installed, to protect property and users from personal injury. The above statement may be modified where repeating coils are used to separate the exposed and unexposed portions of the telephone line. Such repeating coils, however, are generally impracticable on commercial toll lines, due to the loss occasioned by them and to the difficulty in ringing. This latter point will be clearly understood when it is considered that a repeating coil must be designed primarily to transmit as efficiently as possible the feeble voice currents at very high frequencies ranging from 350 to 3,000 P. P. S., and at the same time must be able to transmit the ringing current which generally has a frequency of about 20 cycles per second. Insulated platforms and the like such as used at power stations afford admirable protection to the user of the telephone line, but are obviously out of the question on commercial telephone lines. Further, an attendant at a power station realizes the danger connected with the use of a private line, and acts accordingly. The public, however, as they have good reason to, consider a telephone line harmless, and, therefore, are not particular how they handle the sub-station apparatus.

It has been suggested that insulators affording a greater degree of insulation might be of benefit to a telephone line subject to inductive disturbances. Where the weak spots in the insulation of the entire circuit under proper maintenance exist in the open wire line, better insulators would no doubt reduce the disturbance. In actual practice, however, the weak spots in commercial lines are generally found in the apparatus, insulated wire or cable connected to the open wire line; under these conditions a greater insulation of the latter would be of little or no advantage.

Mr. Miller has pointed out very clearly that the effect of induction on a properly transposed telephone circuit is noticed because of the impossibility of obtaining an absolutely uniform insulation resistance, which results in a flow of current from one side of the line to the other. Uniformity in insulation is entirely independent of the degree of insulation, and it is a factor that can be but imperfectly controlled by careful maintenance.

When considering cases of induction it is sometimes convenient to consider electro-static induction as **potential** induction, since the value of the induced potential from ground on the telephone circuit is dependent upon the potential of the disturbing circuit and is independent of the current and frequency of the latter. On the other hand, electro-magnetic induction may be considered as **current and frequency** induction, since the induced potential in this case is dependent upon the current and frequency of the disturbing circuit and not upon the potential.

From the preceding statement it follows that electro-static and electro-magnetic induction are not in phase with each other, the latter lagging behind the former as the current in the disturbing circuit lags behind the impressed potential.

Mr. Miller's paper is particularly applicable to the Pacific Coast, where the greater part of the disturbance noticed in telephone lines paralleling power lines has been found to be due to electro-static induction resulting from the high potential of the disturbing circuits. Until the advent of the single-phase railway system this electro-static induction was considered to be about the worst enemy of a quiet telephone line. This statement still holds true where the current in the disturbing circuit is not great, and it is for this reason probably that single-phase railroads on the coast have not given telephone companies more trouble than they have. In the East, however, some single-phase systems of great magnitude have been installed, and from all reports the effect on neighboring telephone and telegraph circuits, whether in open wire, aerial, or even in underground cable, to say the least is alarming.

The disturbance in the telephone circuit appears to be due almost entirely to electro-magnetic induction resulting from the powerful alternating field set up by currents of large volume flowing through the trolley and ground return circuits and to the fact that the considerable separation existing between the trolley and the ground return prevents the

inductive effect of one side of the circuit being appreciably neutralized by the opposite inductive effects of the other side of the circuit.

What is particularly disturbing to the telephone engineer is that lead-sheathed cable affords but little protection against this form of induction. At the present time the only solutions to the problem appear to be in obtaining a greater separation between the disturbing and the disturbed circuits or by inclosing the latter in a magnetic shield such as an iron pipe. Both of these remedies are extremely costly, particularly where they must be applied to existing construction.

Mr. Hunt—Gentlemen, is there any one else who can help us out?

MR. F. V. T. LEE.

In my eleven years' experience on the coast, I have heard of more telephone troubles tonight than I have ever heard before. On the other hand, I have heard the most encouraging thing tonight I have heard for a long time, and that is that the telephone companies are beginning to work out solutions of their troubles themselves, instead of simply abusing the power companies.

It is a fact, also, that we have much less trouble and fewer complaints from the telephone companies today than we had seven or eight years ago. We ourselves have improved the insulation of our own telephone lines, as well as of our power lines; but we have generally introduced the grounded neutral due to the increased voltage of our lines. Nevertheless, the telephone companies today are giving better service than they did before, and they have done it in spite of the difficulties that have been introduced in late years, showing a definite advance in the science, and I think this is one of the most promising conditions that we have before us now. Since there has been a more intelligent scientific application of the art of telephony, the troubles have materially decreased, and will continue to decrease until the present crop has entirely disappeared, when we will be ready for the new ones yet to develop.

Mr. Hunt—Gentlemen, I think we have had a very profitable evening, and before adjournment I want to thank Mr. Miller, on behalf of the branch, for starting the discussion for us in the very excellent paper he has given us. If there is nothing further, we stand adjourned.

ENGINEERING HONOR.

Dr. Schuyler Skaats Wheeler, past president of the American Institute of Electical Engineers and president of Crocker-Wheeler Company, recently (May 4) addressed the Engineering Society of Columbia University on the subject of Enigneering Honor. As an under-graduate at Columbia, in the class of '83, he, with Prof. F. B. Crocker, had addressed the same society on technical subjects.

After declaring that he felt the audience before him to be more sympathetic than any of the audiences he had addressed on engineering ethics, he alluded to the ethical codes of the various so-called learned professions. He spoke also of the code which he proposed in his Presidential Address before the American Institute of Electrical Engineers. He said that Francis Bacon had written a brief but comprehensive treatise on this subject in the preface to his "Maximums of the Law," as follows:

"I hold every man a debtor to his profession; from the which as men of course do seek to receive contenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto."

Dr. Wheeler mentioned the three great duties of the engineer in the order of their importance, first the engineer's duty to his client, second to the public, and third to his engineering society. He condemned strongly the publication of false scientific and false engineering statements in the newspapers, and he declared that discoveries and inventions should be announced not in the daily papers, but through the technical societies or the technical press.

EVOLUTION OF CAST IRON PIPE.*

Continued.

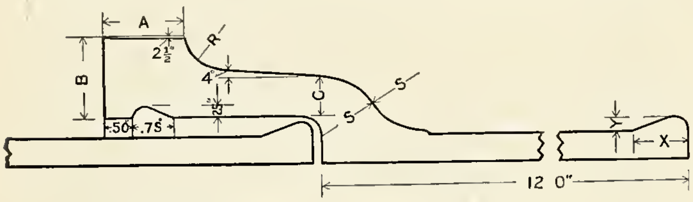
Leakage.—Excessive leakage is often wrongly charged to the bell and spigot joint. In a widely-quoted "Report on the Measurement, Consumption and Waste of Water Supplied to the Metropolitan Water District" (1904), by Dexter Brackett, Esq., Engineer of the Distribution Department, Metropolitan Water Works, Boston, the causes of waste are clearly set forth, but nowhere therein is the bell and spigot joint complained of. It is stated: "Water is wasted, either negligently or wilfully, from mains and service pipe in the public streets, or from pipe and fixtures on the premises of the water takers"; and it is pointed out that the amount of such waste from street mains and service pipe is a much larger percentage of the total consumption than is generally estimated. In this report it is further stated: "In the Metropolitan Water District there are 1,457 miles of pipe, on which there are 750,000 leaded joints, from which leakage may occur." With reference to this

A LONG EASY CURVE WITH FULL LENGTH PIPE.

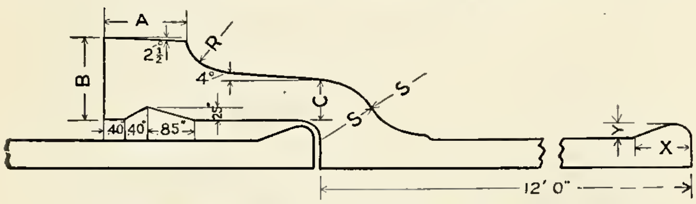
leakage, Mr. Brackett writes: "Under the heading of 'Waste from Street Mains and Services,' the report gives figures which show that there is a large underground leakage from the street mains and service pipe, as distinct from the waste and leakage on the premises of the water takers. In each example given, the street mains and service pipe are considered jointly. No mention whatever is made of the leaded joints as a source of waste. The underground leakage occurs from broken mains and services, from broken connections between mains and services; also services abandoned and left running, and from defects in the leaded joints." Defects in the leaded joints are usually due to outside influences, and otherwise, it may be repeated, are not likely, if due care is exercised in putting down the pipe. It will be noted the report does not hold the leaded joints responsible for waste, but clearly shows how excessive leakage is rather very largely due to broken mains and services which often remain long undiscovered, the water escaping into sewers, into the ground, or into some stream. As an example of this, we quote again from the report: "A very forcible illustration of this source of waste has been furnished in the town of Stoneham. During the first six months of the year 1902, about 800,000 gallons per day were

*Contributed by R. W. Martindale.

supplied to the town. As this quantity appeared larger than was needed for legitimate use, an investigation was instituted for the purpose of learning where the water was used, with the result that four leaks in the street mains were found, which gave no surface indications. After these were repaired the consumption of water fell to 330,000 gallons per day, indicating that 470,000 gallons per day had been wasting from a few unseen defective pipe." In considering this report, it should be borne in mind that many of the mains which were tested form parts of water-works systems installed many years ago, when perhaps not so much care was taken in the laying of pipe as is now generally the case, and in all these years, therefore, it is not surprising that because of settlement and inattention, broken mains and services developed and were overlooked. All of this goes to show that nowadays the problem is hardly that of the leaky joint, for this report is rather an argument for heavier and more permanent mains, carefully laid, and for that "eternal vigilance" in caring for them which will go a long way to insure minimum leakage. On the other hand, a moment's reflection will show that for per-



STANDARD BELL AND SPIGOT FOR GAS.



STANDARD BELL AND SPIGOT FOR GAS WITH ROUNDED GROOVE IN BELL.

manent underground mains, if maximum efficiency and a minimum leakage are to be secured, short-length, light-weight pipe, especially those with bolted joints, are to be avoided.

Standard Cast Iron Pipe and Specials for Gas are now made under the standard specifications of the American Gas Light Association, which specifications were prepared with the assistance of some of the most practical pipe manufacturers in the United States. It should be noted that all gas pipe is also cast vertically in lengths to lay 12 feet, insuring a minimum number of joints and consequent reduction in leakage.

In the built-up sections of cities, where streets are crowded underground with other structures, and surface traffic is heavy, the tendency seems to be to increase the thickness of the metal, and to use exclusively pipe having bells calked with lead, as securing the most flexible joint. Such pipe with lead joints are also preferable where conditions of sub-soil, as in newly made ground, indicate possible subsidence. In any location, these heavier pipe with joints well calked with lead or made with cement, afford the most permanent and safe conduit, naturally costing more than lighter pipe; but when well laid under a paved street will repay such increased cost in requiring fewer disturbances of surface and consequent extra outlays for repaving. To insure good results, the lead joint must be well made; some engineers now twice calk each joint, but care should be taken to properly yarn each spigot, otherwise trouble will result. In looking for the cause of leaky lead joints in a gas main laid near one of our plants, a number of pipe were broken out of the line. On machine cutting lengthwise through the bells of joints which did not leak, it was found that ample yarn had been used and the lead well calked in against it. On the contrary, in cutting through several leaky joints, they were found to have been carelessly made, with the yarn put in loosely, and in some instances so little of it used it might as well have been omitted altogether. No matter whether the pipe be put down with lead or cement, the joints in the trench should be carefully made and tested, preferably before back-filling. This is perhaps more essential in gas than in water mains, and test in the open trench is now the usual practice of leading gas engineers. In gas mains, as with water, the bell and spigot joint is not the only source of leakage. Here again "eternal vigilance," in watching over the distribution mains, services and meters, aids materially to insure a minimum leakage.

CAST IRON MAIN BEFORE TEST IN OPEN TRENCH. ALSO SHOWING CURVE WITH STRAIGHT PIPE BEYOND BEND.

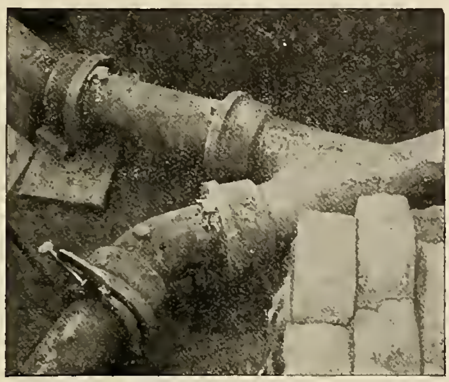
Gas Mains with Cement Joints.—The results obtained with cement joints have been quite remarkable, and account for the growing use of pipe so laid in residence and other sections of cities and towns where the street traffic is comparatively light, as well as in the open country. One of our friends writes that from early in the year 1899, when he began using cement, to early in the year 1905, he has made joints of the following numbers:

Miles of pipe Laid	Size	Number of Feet	Number of Leaks which developed after mains were *covered*, 1899 to 1905.
9 miles 5,020 feet	4 inches	52,540	4
111 miles 2,942 feet	6 inches	589,022	2
6 miles 5,213 feet	8 inches	36,893	1
4 miles 5,158 feet	12 inches	26,278	4
2 miles 5,022 feet	16 inches	15,582	8
3 miles 2,900 feet	20 inches	18,740	10
2 miles 2,693 feet	30 inches	13,253	23
142 miles 2,548 feet		752,308	or 52 leaky joints

out of approximately 80,000 joints of pipe and specials.

In the foregoing piping, all joints are of cement; no lead or expansion joints were used, and the figures seem to establish the cement joint as highly satisfactory. It will be noted,

however, that the number of leaky joints of 20 inches and 30 inches diameter is relatively greater. This is attributed to the fact that they were laid when the men who put them down had little experience in making cement joints of these larger sizes, and before they "appreciated the immense importance of maintaining a nearly constant temperature of joint and contiguous pipe, from the time the joint is made until it has had time to thoroughly set." Another engineer writes of an experience with cement joints extending over thirty-six years. The works now under his charge have about 122 miles of cast iron street mains, 3 inches to 36 inches. In this system, located in New England, no lead joints are used, all pipe and



GAS MAIN WITH LEAD JOINTS.

specials are put down with cement, and no trouble is experienced owing to expansion. While some of the mains are in paved business streets carrying comparatively heavy traffic, they are well laid in comparatively deep trenches, and a leaky joint is very rare indeed, and then nearly always due to outside influence, such as excavations for other mains or structures.

The limit of size of pipe with cement joints seems to vary with different engineers. One uses cement up to 16 inches; another, "up to 12 inches inclusive, and on larger sizes lead joints only, as a leaky joint is not so likely to prove dangerous to the men making repairs." Others, again, use cement joints up to 24 inches on comparatively long mains, while there are

30-INCH CEMENT JOINTS.

cement-joint 30-inch and 36-inch mains of shorter lengths. In the earlier development of cement joints, bells 5 inches deep on smaller sizes, and 6 or even 7 inches deep on larger sizes, have been used, but the results have not been such as to warrant the extra expense. The good results shown in table above were obtained, with slight exceptions, with pipe having bells of the standard dimensions.

Cement Joint Bells and Spigots are often made without grooves in the bell, and generally with somewhat greater joint room than for the lead joint. In making cement joints, the pipe should be supported by blocks in the usual manner, and after starting a joint, it should be completed promptly. In hot weather it is most important to keep the pipe cool and at a uniform temperature until the joint is set—about twenty-four hours. This may be done by covering the pipes with boards and hay, or with about 6 inches of earth kept constantly wet while the sun is on the pipe. During warm

A FRESHLY MADE CEMENT JOINT.

weather, as far as practicable, it is better to make the joints in the early morning, protecting them during the day, and after testing the following morning, back-fill the trench. If it is necessary to make cement joints in freezing weather, care should be taken to warm the joints and avoid exposure to a freezing temperature until set. This involves some extra trouble and expense to provide sheet iron hoods and torches, and to more thoroughly protect the pipe in the open trench. The men handling cement should wear rubber gloves, and be trained to this work. Before entering the bells, the spigot ends of the pipe should be carefully yarned with untarred jute yarn twisted into a rope of about the same diameter as the joint space, and thoroughly grouted with neat cement

CEMENT JOINTS.

mixed with water to the consistency of cream; this yarn should then be well driven against the back of the bell. The cement should be of the best quality, mixed by hand in very small quantities, in the proportion of three-fourths cement to one-fourth water by volume, and thoroughly kneaded. The cement should then be pushed into the socket with a hardwood or steel stuffing tool, then a second piece of yarn as before, twisted around the pipe and driven into the cement with calking tools, after which the joint should be faced by hand with neat cement mixed as above, finishing with a neat fillet around the end of the bell.

(To be continued.)

THE JOURNAL OF ELECTRICITY
POWER AND GAS

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
111 New Montgomery St., San Francisco, California

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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.
Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MAY 30, 1908 No. 22

EDITORIAL.

PSEUDO SCIENCE.

"A little nonsense off and on is relished by the wisest man." Among these is the technical man, who is enjoying no little amusement over the various scientific absurdities recently published in the daily press. Many of these stories are published as regularly in the Sunday supplements as are their cousins, the descendants of the original "Two Hundred and Fifty Jokes," ofttimes disguised so as to almost defy recognition, but by the searchlight of exact knowledge revealed in their pitiable weakness. Some, like the perpetual motion machines, are manifestly impossible; others, such as successful wave-motors, are practically improbable. They are all based upon the mistaken notion that it is possible to get something for nothing. The ordinary newspaper with the utmost guilelessness presents the most preposterous and extraordinary claims of alleged scientists. These claims usually transgress the simplest natural principles so palpably that even the mere amateur readily sees their defects. This is because the editors of the papers that insert these ludicrous marvels are themselves entirely ignorant of the elementary principles of science. There is no more truthful adage than that the "shoemaker should stick to his last."

A good example of this newspaper science is afforded by the description of an electric cannon invented by a "well-known English scientist," who claims that it "will impart an initial velocity of three thousand feet a second to a projectile weighing two thousand pounds, hurling it a distance of three hundred miles, at the rate of a few thousand a day. The weapon has no recoil, noise or smoke, with a life of at least a thousand times greater than the best now in use." It is hardly necessary for us to controvert these statements, other than by saying that the entire output of the California Gas & Electric Corporation, amounting to some 90,000 horsepower, would have to be available for ten minutes to furnish the necessary power to move this mass at the stated velocity.

Nearer home in the classic precincts of Berkeley, the San Francisco Call solemnly states that Professor Voyle, of "Aurum" fame, by means of a divining rod and a psychological compass which can be used only by those possessing occult powers, had mapped out a buried city of the Stone Age. This divining rod is evidently a most dangerous instrument, for it "burned the hand of a lady who attempted to divert its point away from an outward direction." It is to be feared even more than "the high-power line of transmission for electric current from the Colgate power house," which the same paper has discovered to be a menace to successful aerial navigation.

These amusing instances of charlatanism can be multiplied indefinitely and would be harmless if their effect was limited to the risibilities, but unfortunately, nefarious schemes, such as refrigerated cold motors, wireless telephony with invisible wires and compounds for burning ashes, continue to corral a certain credulous class who accept the fairy formulae of fakirs as gospel truth, and who are even so much impressed by technical jargon as to part with their hard-earned coin for these "investments" which are not even speculative.

There is yet another aspect of newspaper science which is even more pernicious, in its attacks upon our financial body. When a newspaper for various reasons is fighting some public-service corporation, any accident or delay of continuous service is avidly seized upon by the sensation monger and luridly depicted to the detriment of the corporation. These distorted reports often contain manufactured details of things which have never occurred and of conditions which never existed. The reporter even supplies deficiency of facts from the figments of his imagination. Naturally these "ink-fish" or "penny-a-liners" have our sympathy in their attempt to earn a livelihood, but we would suggest that the manager or technical superintendent would be only too glad to furnish exact facts.

THE SEMI-ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The semi-annual meeting of the American Society of Mechanical Engineers will be held in Detroit, Michigan, June 23-26. An entire session will be devoted to papers on the conveying of materials, when hoisting and conveying machinery, including belt conveyors, the use of conveying machinery in cement plants, etc., will be discussed.

Among other subjects which will be taken up by professional papers are: "Clutches," with special reference to automobile clutches, by Henry Souther; "Some Pitot Tube Studies," by Prof. W. B. Gregory, of Tulane University, New Orleans, La., and Prof. E. W. Schroder, of Cornell University; "Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck, of Lehigh University; "Horsepower, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. Lionel S. Marks, of Harvard University; "A Journal Friction Measuring Machine," by Henry Hess, of Philadelphia; "A Simple Method of Cleaning Gas Conduits," by W. D. Mount; "A Rational Method of Checking Conical Pistons for Stress," by Prof. G. H. Shepard, of Syracuse University; and "The By-Product Coke Oven," by W. H. Blauvelt.

A lecture on "Contributions of Photography to Our Knowledge of Stellar Evolution" will be delivered by Prof. John A. Brashear, of Allegheny, Pa. The usual receptions will be held and excursions will be made to manufacturing plants, the shipbuilding yards, and various points of interest in and around Detroit. Among the excursions planned is one to the University of Michigan, at Ann Arbor. The gas power section of the society will hold a session, and the Society for the Promotion of Engineering Education and the Society of Automobile Engineers will hold a meeting in Detroit at the same time. As far as possible, sessions will be arranged so that members interested in subjects treated by the other societies may attend their sessions without missing papers on related subjects read before their own society.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on June 17-18, 1908, to secure eligible to fill two vacancies in the position of draftsman, at $4 per diem each, in the office of the surveyor-general of Nevada, at Reno; two vacancies at the same salary in the office of the surveyor-general of Montana, at Helena; and vacancies requiring similar qualifications as they may occur in the General Land Office Service.

An examination will be held on June 17, 1908, to secure eligibles to fill a vacancy in the position of electrician-elevator conductor, $900 per annum, in the Custodian Service at Tampa, Fla., and vacancies requiring similar qualifications as they may occur in the Custodian Service in that city. The examination will consist of letter-writing; practical questions relating to electric wiring, lighting, etc., and experience, both as electrician and as elevator conductor.

"Wrinkles" in connection with the illumination of residence and small stores wa sthe subject of the regular meeting of the Chicago Section of Illuminating Engineering Society, held May 14. Many practical suggestions were brought out, which benefited those present.

PERSONAL.

V. R. Lansingh of the Holophane Company, passed through San Francisco this week on his way East.

R. E. Johnson and W. A. Cooper, civil engineers, have moved from 1370 Franklin Street, Oakland, to Rooms 1036-1037, Mills Building, San Francisco.

O. Weimer, electrical engineer, Wagner Mfg. Co., of St. Louis, Mo., has been visiting San Francisco during the past week. He will continue his trip East by way of Seattle.

D. W. Pontius, of Riverside, Cal., on May 1 became traffic manager of the Los Angeles-Pacific Railway, vice F. A. Short, who has been assigned to other duties.

J. J. Mullen representing the Moloney Electric Co. of St. Louis, Mo., manufacturers of high grade transformers, has left San Francisco on his way North after making arrangements for a local agency.

Herbert C. Petty has been elected a director of the Crocker-Wheeler Company. Mr. Petty accepted a position in the sales division of the company January, 1903, and has advanced rapidly to the position of contract manager.

TRADE CATALOGUES.

The Sprague Electric Co., 527 West 34th St., New York City, send an illustrated folder displaying the Sprague line of Stamped Steel Boxes.

H. W. Johns-Manville Co., 100 William St., New York City, send two interesting booklets, one showing tbe advantages of Keystone Hair Insulator for weatherproofing and sound deadening, and the other describing the Success Fire Extinguisher.

Bulletin No. 1106 from Fort Wayne Electric Works, of Fort Wayne, Indiana, illustrates and describes Direct Current Switchboard Panels for Small Plants. Instruction Book No. 3032 is a valuable manual on the installation and operation of Fort Wayne Series A. C. Arc System. Fort Wayne Fan Motors are graphically portrayed in Booklet 4507. No. 4064 presents a valuable Meter Reading Book, giving permanent record for every Central Station. These Bulletins will be sent upon application.

REMOVAL NOTICE.

The Wagner Electric Mfg. Co. has moved its offices from Oakland to Rooms 312-314 Balboa Bldg., Market and Second Sts., San Francisco.

The Tracy Engineering Company, contractors for high-economy steam power plants, have moved from 1647 Page Street to 461 Market Street, San Francisco.

The New York office of the Fort Wayne Electric Works, formerly at 40 New Street, has been moved to the fifteenth floor of the Cortlandt Building, 30 Church Street.

TRADE NOTICE.

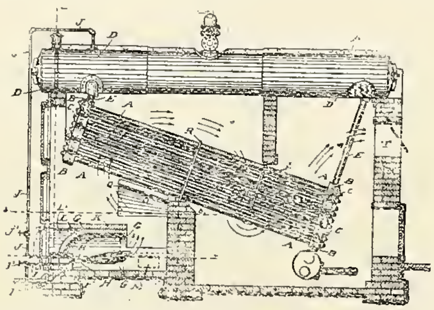
The "Street Railway Journal" and the "Electric Railway Review" have been consolidated and, commencing with the issue of June 6, 1908, will be published weekly as the "Electric Railway Journal" by the McGraw Publishing Company, of New York City.

Surplus heat from electric generators at the Trollhättan, Sweden, power station is used to warm other parts of the building. Each generator is furnished with a fan that draws cold air from the outside and drives it through the generator to the places requiring artificial heat. This power plant develops 10,000 horsepower.

PATENTS

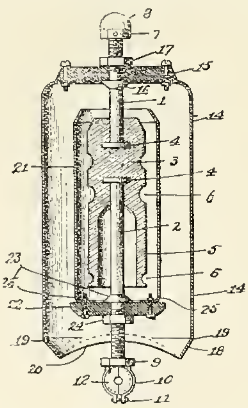
BURNING OIL FOR GENERATING HEAT. 887,409. Thomas C. Mason, Los Angeles, Cal., assignor, by direct and mesne assignments, to Mason Smokeless Combustion Company.

The apparatus for burning oil for generating heat, consisting of a combustion chamber, an arch therein, an externally fired steam boiler, a burner whereinto oil and steam are led in regulated quantity, situated within and near the inner end of combustion chamber, flues one at each side of the apparatus, openings for admitting air into flues, doors on said openings for regulating the quantity of air admitted, an arch above the arch of the combustion chamber, inclosing spaces forming parts of the flues, these flues leading into a transverse flue, and a discharge flue, from which the heated air is discharged both beneath and above the burner, an upwardly inclined arch at the rear part of the apparatus and at a higher level than the combustion chamber, for directing the heat and products of combustion up among the upper ends of the inclined tubes of the externally fired steam boiler.



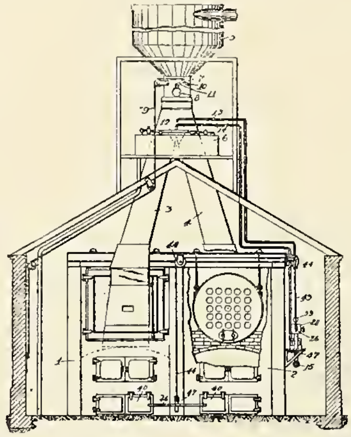
ELECTRIC INSULATOR. 887,336. Herman Mieth, Vallejo, Cal.

In an insulator, upper and lower holding rods having flanges at their inner ends and shoulders on the outer ends, insulation interposed and surrounding the flanged inner ends of rods to connect the same, an insulating petticoat on insulation extending over the lower holding rod, a disk of insulating material clamped against the shoulder on the outer end of the upper holding rod, a main cylindrical casing having an inwardly flared lower edge secured to disk surrounding rods and the interposed insulation, a second disk of insulating material clamped against the shoulder on the outer end of the lower holding rod, and an auxiliary cylindrical casing having an inwardly flared upper edge secured on second disk extending upwardly into main casing over rods and the interposed insulation.



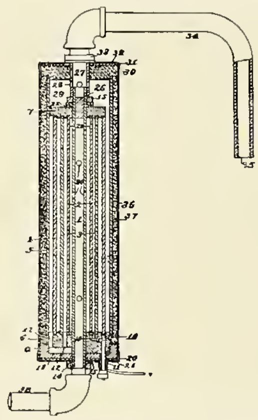
REGULATOR FOR BOILER-FEEDERS. 887,086. George W. Gardner, San Francisco, Cal.

In a regulator for boiler feeders, a charge chamber, water controlled means for emptying the same, a damper for the furnace, and means for simultaneously controlling means and the damper by the steam pressure.



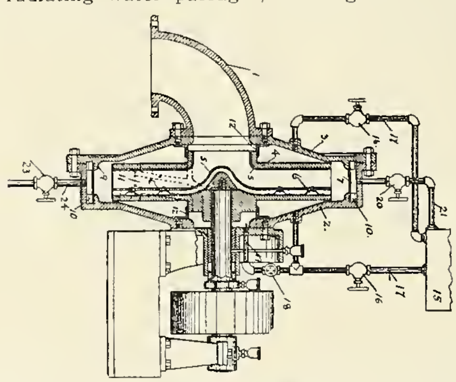
ELECTRIC WATER-HEATER. 887,331. Oscar Johnson, Seattle, Wash.

An electrical liquid heater having a series of nested tubes grouped in pairs, means connecting the annular spaces between the tubes of the pairs to constitute a liquid conducting passage, and means for forming opposite electrical connections with the respective tubes of the pairs.



CONSTRUCTION OF CENTRIFUGAL PUMPS. 887,658. Ferdinand W. Krogh, San Francisco, Cal.

In a centrifugal pump, the combination of an impeller having radiating water passages, a lining for the passages, the lining being in part secured close against the body of the impeller and in part separated therefrom, and cushioning springs interposed between the frame of the impeller and the parts of the lining that are set away therefrom.



INDUSTRIAL

AN APPROVED ELECTRIC BATTLESHIP.

During the visit of the Atlantic fleet to San Francisco, the Electric Railway & Manufacturers' Supply Co., 84-86 Second Street, San Francisco, prepared a most attractive window display, as is shown in the accompanying photograph.

In one window was a miniature battleship consisting entirely of small electrical apparatus; in the other window was an American flag built up of colored incandescent lamps; these were surmounted by flags and ribbons fluttering in the breeze from electric fans. The battleship was particularly worthy of note, as it was constructed of so many varied kinds of apparatus, and was the result of great ingenuity and patience on the part of the boys in the store.. To them we are indebted for the following details:

The hull consisted of 44 Trumbull No. 2199 plug cut-outs, 8 Trumbull No. 2965 plug cut-outs, 8 Trumbull single-pole N. C. fuse blocks No. 25,693, 12 No. 5½ porcelain knobs.

The deck consisted of 124 carbon brushes.

Each of the two masts was built up of 1 quart can Electro Black, 1 roll Kachouc tape, 1 1-lb. can Highland Paste, 1 1-lb. spool annunciator wire, 1 trolley wheel, 1 1-lb. can fuse wire, 1 No. 9185 keyless receptacle, 1 ¼-in.x1-in.x8-in. carbon brush, 1 stick Highland soldering paste.

The three smoke-stacks consisted of 3 miners' E. R. flashlights.

The bridge consisted of 4 feet annunciator wire, 26 binding posts.

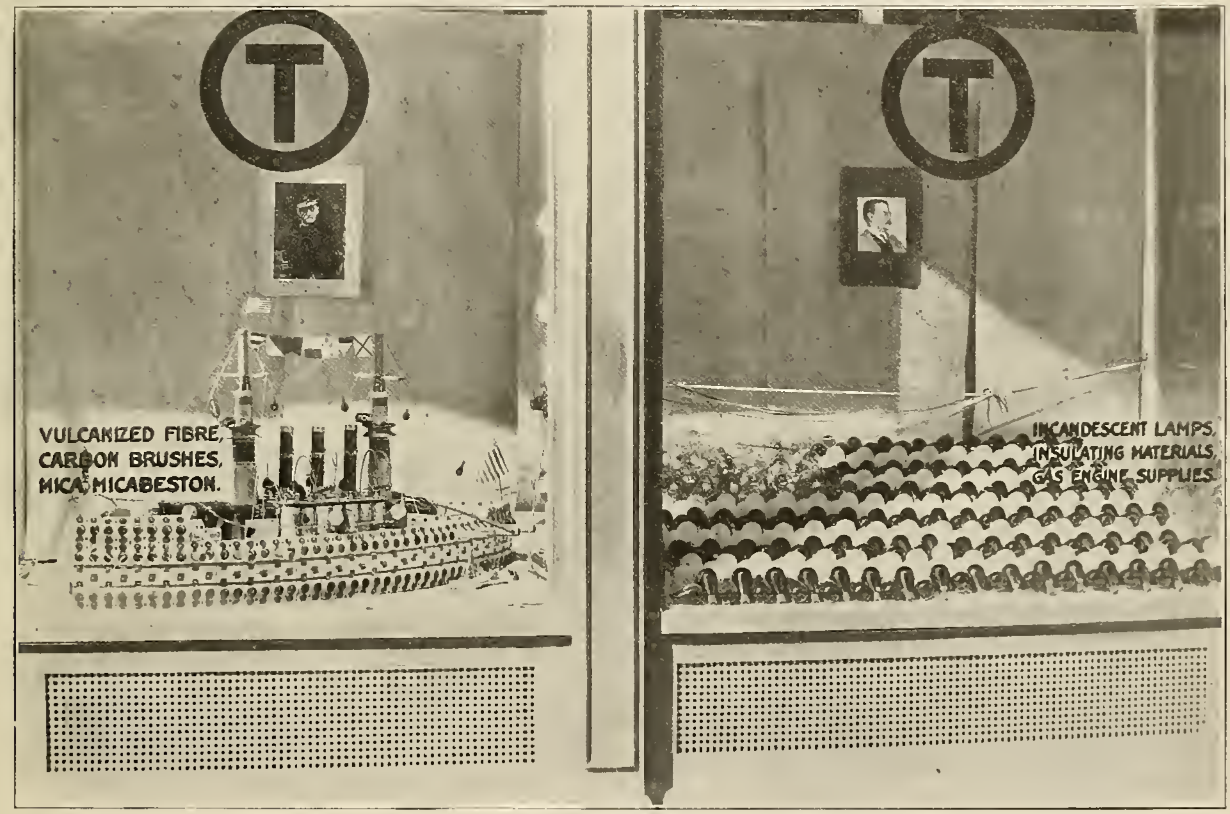
The upper deck was made up of one piece 3 16-in. red fibre 10x16 inches, and 40 cans, 1-lb. each, Chicago fuse wire.

The four life-boats were Clayton & Lambert drip cups, suspended by eight pieces of No. 14 rubber-covered wire.

Four Ericsson hand micro-mouthpieces were used as ventilators.

A 14-volt 1-candlepower lamp inside a No. 9386 socket shell was used in each of the two searchlights.

The fighting tops consisted each of 1 trolley wheel with 2 30-ampere National code fuses for rapid-firing guns.



AN APPROVED ELECTRICAL BATTLESHIP AND FLAG.

The bridging was done with 12 feet of No. 18 lamp cord Two pieces of wire solder were used as anchors.

The large guns, as well as those on the side and rear, consisted of flash-lights. The lower guns were made from tubes of soldering paste.

One E. R. battery ammeter mounted on a No. 50,748 receptacle shell, covered with a telephone mouthpiece, served as a compass.

The lighting was done with eight 14-volt, 1-candlepower lamps, arranged in series.

The tender on one side was made of a Thermo sleeve iron, watch-case buzzer, No. 50,746 receptacle shell, 1 midget fuse, 1 14-volt 1-candlepower lamp.

The outrigger consisted of 1 fibre rod, ⅝-in.x30-in.

The ladder, made from No. 18 magnet wire, completed the equipment, making a total of 176 separate pieces.

HUNT, MIRK & CO., INC., ENGINEERS.

The accompanying cut shows the new offices of Hunt, Mirk & Co., Inc., Engineers, at 141 Second Street, where they are now permanently located.

In a recent interview with these engineers, they report that all indications point toward a general revival of business in their field of work. Negotiations for power-plant work that were under consideration last fall, and held up on account of financial disturbances, are again active, and as the money market improves, many of these new enterprises will result in orders.

This company reports the following recent sales and power-plant work under construction:

NEW OFFICES OF HUNT, MIRK & CO., INC., ENGINEERS.

For the San Diego Electric Railway Company, they are just finishing an addition to their electric generating station, consisting of two 500-kilowatt alternating-current Westinghouse-Parsons turbo-generator units, with Worthington surface condensers, boilers, and auxiliaries.

In the city of Alameda plant, a 650 K. V. A. alternating-current Westinghouse-Parsons turbo-generator unit, with Worthington condenser and auxiliaries, has just been put into commercial operation.

For Claus Spreckels, this company is now erecting a new steam turbine power plant, which includes two 650 K. V. A. alternating-current Westinghouse-Parsons steam turbines and generators, Worthington condensers, cooling tower, Stirling boilers, two 150-kilowatt motor-generator sets, engine and motor-driven exciter sets, switchboard, etc.

The Consumer's Light & Power Company have just closed a contract with this company for a complete plant to be located in the Whitney Building on Geary Street. The plant will consist of three 300-kilowatt generators direct connected to American-Ball angle compound engines, one 125-kilowatt generator direct connected to an American-Ball duplex compound engine, together with water-tube boilers and auxiliary apparatus necessary for a complete station. The Consumer's Light & Power Company will also go quite extensively into the district steam heating business, which is a new departure in San Francisco.

For the Panhandle Lumber Company, Ltd., of Spokane, Wash., contract is about completed for installing two 650 K. V. A. alternating-current turbo-generator units with condensers and auxiliaries, at Spirit Lake, Idaho.

A 6,000-kilowatt double-flow alternating-current Westinghouse-Parsons turbo-generator unit sold to the City Electric Company, to be installed in their North Beach plant, is now being put on its foundations, and is a repeat order. The City Electric Company is now operating two 2,500-kilowatt Westinghouse turbos erected on a previous order.

For the Grays Harbor Railway & Light Company, Aberdeen, Wash., a 1,000-kilowatt Westinghouse turbo-generator has just been put into commercial service.

For the Southern Pacific Company's new electric generating station at Fruitvale, Cal., this company has secured the order for two 5,000-kilowatt Westinghouse-Parsons turbo-generators and two 12,000-square-foot Worthington surface condensers and auxiliary apparatus.

Hunt, Mirk & Co., Inc., are the Pacific Coast representatives of the Westinghouse Machine Company, of East Pittsburg, Pa., for their entire production, and are the pioneers in the introduction of the Westinghouse-Parsons steam turbine throughout the coast States. They state that while the Westinghouse-Parsons steam turbine has been in successful

commercial service throughout the East for the past twelve years, it is only three years ago that the first one was put into operation on the Pacific Coast, and, whereas the competition with the reciprocating engine was very keen at that time, purchasers of steam prime movers at the present date, in sizes as large as 300 kilowatts, almost without exception are considering the steam turbine to the exclusion of the reciprocating engine. Over 750,000-kilowatt rated capacity of Westinghouse-Parsons turbo-generator units are now in operation or on order.

The following data concerning Westinghouse-Parsons steam turbines on the Pacific Coast will be of interest:

Westinghouse Turbines in Operation on the Pacific Coast.

	Kilowatt Rated	Aggregate Rated B.H.P.
The Edison Electric Co., Los Angeles, Cal.	7,500	11,250
Los Angeles Pacific Co., Los Angeles, Cal.	2,750	4,125
San Diego Electric Railway Co., San Diego, Cal.	1,000	1,500
Mt. Whitney Power Co., Visalia, Cal.	1,000	1,500
North Shore Railroad Co., Alto, Cal.	1,000	1,500
Everett Light & Railway Co., Everett, Wash.	750	1,125
*California Powder Works, Pinole, Cal.	650	975
*San Diego Electric Railway Co., San Diego., Cal.	500	750
*San Diego Electric Railway Co., San Diego, Cal.	500	750
North Mountain Power Co., Eureka, Cal.	500	750
Lewiston Water & Power Co., Lewiston, Wash.	400	600
Grays Harbor Railway & Light Co., Aberdeen, Wash.	400	600
California Powder Works, Pinole, Cal.	400	600
Los Angeles Gas & Electric Co., Los Angeles, Cal.	3,000	4,500
City Electric Co., San Francisco, Cal.	2,500	3,750
City Electric Co., San Francisco, Cal.	2,500	3,750
*Grays Harbor Electric Co., Aberdeen, Wash.	1,000	1,500
Luna Park Amusement Co., Seattle, Wash.	300	450
Merchants' Mutual Light & Power Co., Santa Barbara, Cal.	300	450
Claus Spreckels, San Francisco	650	975
Claus Spreckels, San Francisco	650	975
City of Alameda, California	650	975
Panhandle Lumber Co., Spokane, Wash.	650	975
Panhandle Lumber Co., Spokane, Wash.	650	975
On Order and Being Erected.		
*City Electric Co., San Francisco, Cal.	6,000	9,000
Southern Pacific Co., Fruitvale, Cal.	5,000	7,500
Southern Pacific Co., Fruitvale, Cal.	5,000	7,500
Totals	46,200	69,300

*Repeat order.

LAST YEAR'S TURBINE BUSINESS.

Retrospective of the development during the past year of the steam turbine, the accompanying figures reported by the Westinghouse Machine Company are interesting as tending to controvert the general impression that the turbine business suffered heavily during the year. Although one month's business in 1906 still holds the record at 62,100 kilowatts, the year 1907 was marked by an average demand quite as large. As late as July, orders for 34,750 kilowatts were taken during that month, as compared with 25,750 for July, 1906, which is a particularly gratifying showing. For the first nine months of each year the demand for turbines was as follows: 1907, 158,550 kilowatts, and for 1906, 152,400 kilowatts. Or, taking the middle six months of the year, from April to September inclusive, thus excluding the usual midwinter activity, as well as the late depression, the average per month is as follows: 1907, 15,833 kilowatts; 1906, 14,365 kilowatts. Thus, it is apparent that up to the period immediately preceding the depression of October the demand for turbine equipment shows a steady increase. It is interesting to note in this connection, the ultimate results of commercial activity of the past few years. Had the business of the company kept on increasing at the same rate as prevailed during 1904 and 1906, the year 1910 would have been marked by an annual output of 1,912,000 kilowatts, or the rate of 160,000 kilowatts per month

NEWS NOTES

WATERWORKS.

Roy, N. M.—The Roy Waterworks Company has entered into a deep well contract to supply the town with water. A drilling outfit was placed on the townsite last week.

Santa Barbara.—The Board of Supervisors has passed Ordinance 325, granting the Montecito Improvement Company a franchise for a pipe line upon certain roads and highways of Santa Barbara County.

Salt Lake City.—A contract has been let for a waterworks system for the town of Florence. The contract was let to Captain A. O. Girard and Salt Lake associates, by George A. Lane and Z. Bryan, owners of the townsite.

Fort Baynard, N. M.—The Government has purchased over 25,000 acres here with the purpose of adding to Baynard territory and that the fort might be able to install a gravity water system, the total cost of which Mr. Conlan, the post architect, estimates at $100,000, including the $22,000 for the 3,000-gallon tank now under erection, a water main of over five and one-half miles and the reservoirs at springs from which the water is to be taken.

San Francisco.—An agreement as to the principal features of the water-rate ordinance was reached at a meeting at which were present the members of the special water committee, the members of the public utilities committee, the chairman of the hospital and health committee, and the chairman of the finance committee. It was agreed that the special committee should report to the board that the ordinance of 1902, under which the Spring Valley Water Company is now collecting, be re-enacted, with the change that the hydrant rate be $2.50 a month. At the present time the city is paying $1 a month for about 4,000 hydrants. Allowing for new hydrants to be installed, the budget will provide $125,000 for hydrants, $20,000 for water supplied to school buildings, $6,000 for street sprinkling, $15,000 for municipal building, and an equal amount for parks, making in all a total of $181,000.

OIL.

Los Angeles.—Fire destroyed the power plant of the Harris Oil Company, with a loss of $1,500, recently.

Coalinga.—The Associated Oil Company is having a shipping tank built to hold 37,500 barrels, on Section 8-21-15, upon an elevation allowing the oil to gravitate to its loading track on the same section. The Bunting Iron Works are the builders.

Riverside.—The Standard Oil Company, which recently lost its warehouses in this city by fire, will rebuild in the old location, Pachappa Avenue and East Fifth Street. The company will erect a brick warehouse with a galvanized-iron pump house.

Los Angeles.—It is reported that English capitalists have acquired holdings in the Pittsburg-Salt Lake Oil Company, owned principally in Salt Lake City. New capital will be used in fully equipping the rubber and asphalt departments of the company, which has offices here.

San Luis Obispo.—Lyman Stewart, president of the Union Oil Company, confirms the report that the Standard Oil Company has contracted with the Union for the purchase of 200,000 barrels of Santa Maria oil at $1 per barrel. The contract calls for delivery within two years.

ILLUMINATION.

Sawtelle.—Subscriptions for a gas plant project are being sought by members of the Sawtelle Commercial Club to supply gas to the town and vicinity.

Orange.—At the last meeting of the City Council the petition for the submitting of a proposition to vote $40,000 bonds for establishing a municipal gas plant was denied.

Santa Monica.—The City Council has passed a resolution of intention for the installation of 22 ornamental cluster lights on the 30-foot cement walk extending from Pier to Hollister Avenue.

Pasadena.—Seven bids were opened by the City Council for supplying transformers and other electrical supplies for the municipal lighting plant. The bidders were: B. F. Kierulff, Jr. & Co., Maloney Electrical Company, Westinghouse Electrical & Manufacturing Company, Enterprise Electrical, General Electric Company, and the Wagner Electrical Manufacturing Company.

Reno.—While boring for water on the island ranch owned by State Senator Douglass, in Churchill County, laborers encountered a strong flow of natural gas. The find has created considerable excitement in the section, which is close to Fallon. The flow is strong and steady. The gas was lighted soon after it was discovered and burned several hours, or until it was extinguished by the laborers, who hurried to Fallon to report their find. Arrangements are under way to pipe the gas to Fallon and surrounding mining camps. It is believed that the gas overlies an oil strata.

INCORPORATIONS.

Los Angeles.—The Walker-Heck Oil Company has been incorporated with a capital stock of $150,000 by Hattie Malloy, K. H. Kennedy, G. W., Margaret S. and Ethel G. Walker.

Ontario.—The Independent Home Telephone Company has been incorporated by J. A. Fletcher, R. P. Cardew, L. R. Kennedy, J. N. Hartley, and R. Duncan. The capital stock of the company is $200,000.

Los Angeles.—Articles of incorporation have been filed with the County Clerk for the Imperial Water Company. Its purpose is to acquire, by purchase or otherwise, water for use on the lands in its district.

Los Angeles.—Articles of incorporation have been filed by the Iowa Land & Water Company, with a capital stock of $250,000. The directors are John Metcalf, M. J. Nolan, W. A. Gage, C. H. Kegley, and Jos. Harker.

TRANSMISSION.

Placerville.—T. C. Purcell has filed a notice of location of 2,000 inches of water in the Cosumnes River, to be diverted on the north bank of the river for power and other purposes.

Sacramento.—The Board of Supervisors opened a bid for the franchise asked for by the Great Western Power Company to erect towers, poles, and monuments and stretch wires and cables for transmission of electric energy through the county roads and highways for 50 years. The only bid that was made was that of the Great Western Power Company, for $100, which was accepted.

FINANCIAL.

Porterville.—An ordinance was passed by the Trustees at their last meeting ordering the sale of the bonds for the waterworks.

Alturas, Cal.—The Alturas Electric Light & Power Company will hold a meeting of the stockholders on June 22d to consider increasing the capital stock.

Santa Cruz.—The City Council took preliminary steps on May 21 for bonding the city for $100,000 for the expansion of the electric light system and water supply and for other purposes.

Yuba City.—At the last meeting of the Town Trustees it was decided to employ an engineer to prepare plans and estimates for a water system, for which bonds will be voted when its cost is estimated.

San Francisco.—The bond election in San Francisco showed an overwhelming majority in favor of all six propositions, the vote being about 21,000 for to 1,600 against. The amount of $5,200,000 was voted for an auxiliary water system.

Los Angeles.—A resolution has been passed authorizing the sale of $340,000 waterworks bonds, which are a part of the issue of $23,000,000 bonds authorized at a special election held June 12, 1907. The bonds will be issued in denomination of $200 each.

San Francisco.—Schedules of the liabilities and assets of the Porter-Gribble Electric Company have been filed in the United States District Court, the debts of the company amounting to $12,360.41, with $3,315 assets. Steps to have the company adjudged bankrupt were taken several weeks ago by the creditors.

Oakland.—All the property of the San Francisco, Oakland and San Jose Consolidated Railway, known as the Key Route, has been deeded in trust to the Union Trust Company of San Francisco to secure a bond issue of $3,000,000 recently authorized by the directors. The list of property includes the right of way, rolling stock, shop equipment, and ferry boats owned by the railway.

Los Angeles.—It has been announced that the American Petroleum Company, of this city, has acquired 1,200 acres of oil land in the heart of the Coalinga district in Fresno County. The bond issue of $2,000,000 just voted by the company for this purpose includes an appropriation for development. Among the sellers are the Pleasant Valley Farming Company, the Ajax Oil Company, H. H. Welsh, and Thomas A. O'Donnell.

Los Angeles.—Action was taken on May 21 by the directorate of the Union Oil Company at the monthly meeting at Oleum, whereby the capitalization of $10,000,000 was increased to $50,000,000. A new company was formed to include all the subsidiaries. Last year's earnings of the company were over $2,000,000, and it was thought that the capitalization was too limited to permit of the expansion under contemplation.

Berkeley.—The report of the Berkeley Electric Lighting Company for the half year ending with the month of March was filed with the town clerk last week, and the 3 per cent of the gross receipts of the company which, according to the contract made at the time of granting the franchise, is due the town, was turned over to the treasurer. The amount received was $3,778.35. This amount is practically the same as the regular semi-annual amount turned into the town treasury upon the completion of the report of the company. It represents a total gross receipt by the company of $125,945 for the six months ending last March.

San Francisco.—President Patrick Calhoun's statements of the earnings of the United Railroads Company for the first three months of this year show gross receipts of $1,522,716, as compared with $1,606,022 for the corresponding period of 1907. Estimated figures of the company's receipts for April and the first half of May indicate that the company will probably by the end of June overcome this decrease and run ahead of those of the first half of last year. The receipts for the first eleven days of the month were the largest in the history of the company. In 1905 the company's receipts reached high-water mark with $7,066,892. In 1906 they amounted to $5,955,786, and last year to $4,745,116. In March of this year the earnings were $537,700, the first month they exceeded the half-million mark since the beginning of the strike in May, 1907.

TRANSPORTATION.

Tropico.—Much interest is being shown in the proposed electric line which will soon connect Tropico and Burbank. A bonus of $30,000 is asked for a free right of way.

Santa Ana.—It is reported that the Southern Pacific Company will electricize its track between this place and Newport Beach within 90 days, and that this company and the Pacific Electric will build a union depot at Newport.

Oakland.—A petition has been presented to the Supervisors of Alameda County by Joseph Naphtaly asking for a franchise for the construction and operation of an electric railway to connect Alameda and Contra Costa Counties by means of the inter-county tunnel through the Berkeley hills. The Supervisors received the petition, but deferred action until next week, when a special meeting will be held to consider the matter.

Berkeley.—The Oakland Traction Company has begun the work of laying rails along Dana Street north from Bancroft Way to Alliston Way, preparatory to relieving the street-car congestion on Shattuck Avenue by a loop line over Dana, Alliston Way, Oxford and University Avenues. When this loop is completed, the Telegraph Avenue cars will make a continuous trip from Oakland and back without turning the trolley. Northbound cars will run over the new loop, and returning will follow the present route over Bancroft Way from Shattuck to Telegraph.

San Francisco.—The United Railroads has formally adopted the new system of numbering the various street-car lines, which has been under consideration by the officials for some weeks. The system will be inaugurated in compliance with an ordinance passed by the Board of Supervisors requiring the company to place a distinguishing number on each car line where it can be readily seen by the public. While this system has never been used in the United States, it has been used successfully in many cities of Europe, notably in Berlin. Every line which operates on tracks with other lines has been given a number, and each car will have the number displayed in the front and rear in a box that will be illuminated at night. No confusion can result from the system, as the car lines will also have their old names, but it is expected that the numbers will in time replace the street names. The following is the schedule of the numbers as adopted: No. 1, Sutter Street; No. 2, Sutter and Sacramento; 3, Sutter and Jackson; 4, Turk and Eddy; 5, McAllister; 6, Masonic Avenue; 7, Haight; 8, Market; 9, Valencia; 10, Guerrero; 11, Mission and Twenty-fourth; 12, Ingleside; 14, Cemeteries; 15, Third and Kearny; 16, Kentucky; 17, Ninth and Polk; 18, Mission and Polk; 19, Bryant and Polk; 20, Ellis and Ocean; 21, Hayes and Ellis; and 22, Fillmore. There will be no No. 13. The number was avoided by the company, especially as that dreaded number would have fallen in its place in the schedule to the cemeteries line.

Classified List of Advertisers

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General Electric Co.
Standard Electrical Works.
Western Electric Co.

Aluminum Electrical Conductors
Pierson, Roeding & Co.

Annunciators
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Asbestos Products
Johns-Manville Co., H. W.

Bases and Fittings
Chase-Shawmut Co.

Batteries, Primary
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Boilers
Keystone Boiler Works
Moore, C. C. & Co., Inc.
Robb-Mumford Boiler Co.
Standard Electrical Works
Tracy Engineering Co.

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Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

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General Electric Co.
Northern Electrical Mfg. Co.

Building Material
Bonestell, Richardson & Co.
Johns-Manville Co., H. W.
Paraffine Paint Co.

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Reisinger, Hugo

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Electric Appliance Co.
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O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.

Conduits
American Circular Loom Co.
Electric Appliance Co.
National Conduit & Cable Co.
Pierson, Roeding & Co.
Standard Electrical Works.
Sterling Electric Co.

Conduit and Moulding Hangers.
Chase-Shawmut Co.

Conduit Fixtures
Bossert Electrical Con. Co.
Electric Appliance Co.
Standard Electrical Works.
Sterling Electric Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Electric Appliance Co.
Sterling Electric Co.

Dynamos and Motors
Brooks-Follis Elec. Corp.
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Grinders
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Western Electric Co.

Electric Heating Devices
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.
Vulcan Electric Heating Co.

Electrical Instruments
Cutter Co., The
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kierulff, Jr. & Co.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
Crocker-Wheeler Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
General Electric Co.
B. F. Kierulff, Jr. & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Brooks-Follis Elec. Corp.
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co
Standard Electrical Works
Johns-Manville Co., H. W.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Western Electric Co.

Electric Ventilating Fans
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Engineers, Chemical
Moore & Co., Chas. C., Inc.
Smith, Emery & Co.
Standard Electrical Works
Tracy Engineering Co.
Westinghouse Machine Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.

Engineers and Contractors
Brooks-Follis Elec. Corp.
Cory, C. L.
Copeland, Clem A.
Goeriz & Co. O. C.
General Electric Co.
Jackson, D. C. & W. B.
Moore, C. C. & Co., Inc.
Smith, Emery & Co.
Standard Electrical Works
Sterling Electric Co.
Thaxter, H. C.
Tracy Engineering Co.
Van Norden, Rudolph W.
Western Electric Co.
Westinghouse Elec. & Mfg Co.

Feed Water Heaters and Purifiers
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.
C. H. Wheeler Mfg. Co.

Fire Proofing
Johns-Manville Co., H. W.

Fuses and Fuse Devices
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Ground Connection Clamps
Chase-Shawmut Co.

House Goods
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.

Hydraulic Machinery
Goeriz & Co., O. C.
Moore, Chas. C. Co., Inc.
Pelton Water Wheel Co.
Standard Electrical Works.
Tracy Engineering Co.

Injectors
Vulcan Iron Works

Insulators and Insulating Material
Bossert Elec. Cons. Co.
Brooks-Follis Electric Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
Okonite Co., Ltd.
Pierson, Roeding & Co.
Standard Electrical Works.
Standard Undergrnd Cable Co.
Sterling Electric Co.
Thomas Insulator Co.
Western Electric Co.

Lamps, Arc
Benjamin Electric Mfg. Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent
Bryan, Marsh Co.
Electric Appliance Co.
California Incand. Lamp Co.
Holabird-Reynolds Elec. Co.
Johns-Manville Co., H. W.
General Electric Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Line Material
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Meters, Electric
Duncan Elec. Mfg. Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kierulff, Jr. & Co.
Standard Electrical Works.
Westinghouse Elec. & Mfg. Co.

Meters, Gas
Pacific Meter Co.

Mining Machinery
Moore, Chas. C. Co., Inc.

Motors
Century Electric Co.
Crocker-Wheeler Co.
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Northern Electric Mfg. Co.
Pierson, Roeding & Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Nipples
Chase-Shawmut Co.

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Chase-Shawmut Co.

Outlet Bushings and Locknuts.
Chase-Shawmut Co.

Paint, Insulating
Paraffine Paint Co.
Standard Electrical Works.

Pins
Benicia Iron Works

Pipe
Pierson, Roeding & Co.
Schaw-Batcher Co., The

Pipe and Boiler Coverings
Johns-Manville Co., H. W.

Poles, Ties, Brackets, etc.
B. F. Kierulff, Jr. & Co.
Barnes-Lindsley Mfg. Co.

Pole Lines
Pierson, Roeding & Co.
Benicia Iron Works.

Power Plants
General Electric Co.
Moore & Co., Chas. C., Inc.
Standard Electrical Works.
Tracy Engineering Co.

Pumping Machinery
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Pumps, Centrifugal
Moore, C. C. & Co., Inc.

Pumps—Air Lift and Artesian
Hunt, Mirk & Co.

Pumps, Steam
Moore, Chas. C. Co., Inc.
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Tracy Engineering Co.

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Chase-Shawmut Co.

Steam Plant Equipment
Tracy Engineering Co.

Steam Boilers
Moore & Co., Chas. C., Inc.
Standard Electrical Works.
Tracy Engineering Co.

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Johns-Manville Co., H. W.

Storage Batteries
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Bossert Elec. Cons. Co.
Electric Appliance Co.
General Electric Co.
B. F. Kierulff, Jr. & Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Sterling Electric Co.
Western Electric Co.

Tape
Electric Appliance Co.
General Electric Co.
B. F. Kierulff, Jr. & Co.
Okonite Co., Ltd.
Standard Electrical Works
H. W. Johns-Manville Co.

Telegraph Apparatus
Sterling Electric Co.

Telephones and Supplies
Brooks-Follis Elec. Corp.
Electric Appliance Co.
B. F. Kierulff, Jr. & Co.
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Standard Electrical Works
Western Electric Co.

Tested Fuse Wire and Links.
Chase-Shawmut Co.
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Test Lamps, Pocket
Chase-Shawmut Co.

Transformers
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
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Traps, Steam
Moore, Chas. C. Co., Inc.

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Electric Appliance Co.
General Electric Co.
Habirshaw Wire Co.
Indiana Rubber & Insulated Wire Co.
B. F. Kierulff, Jr. & Co.
New York Insulated Wire Co.
Okonite Co., Ltd.
Nat. Conduit & Cable Co., The
Simplex Electrical Co., The
Sterling Electric Co.
Standard Electrical Works.
Standard Undergrnd. Cable Co.
Western Electric Co.

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., JUNE 6, 1908 No. 23

AN ELECTROLYTIC SWITCHBOARD

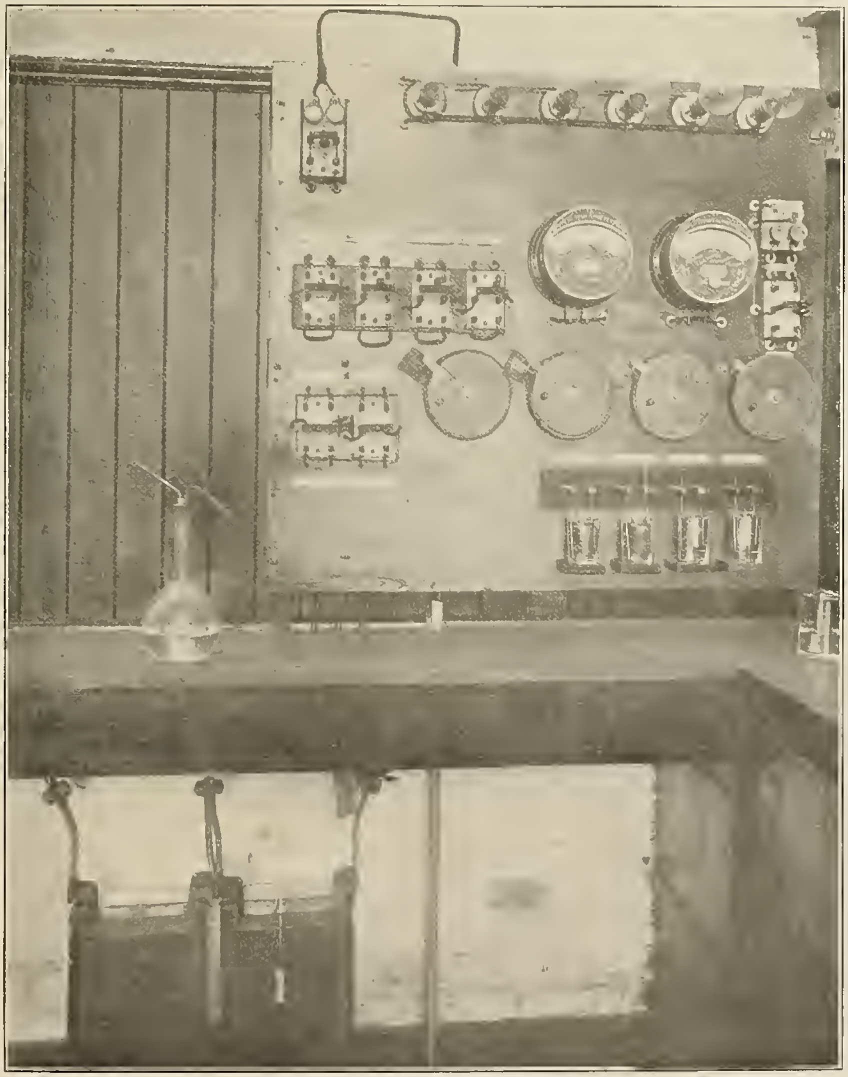
By LOUIS J. BORIE

The switchboard herein described was designed and installed by the writer at the request of the Bretherton Metallurgical Co., in their laboratory at 532 Commercial St., San Francisco.

The switchboard is used in electrolytic determinations of copper and other metals on control and umpire work, and in its construction it was sought to combine low initial cost with maximum convenience of manipulation.

The board proper, measuring 3 feet by 3 feet 6 inches, is made of well seasoned 1-inch redwood planks, glued together and prevented from warping by end strips affixed in the usual manner. Two coats of paraffine paint preclude absorption of moisture. The board stands out from the wall about two and one-half inches, and is hinged to allow for inspection of connections.

Referring to accompanying cut, it will be noted that four determinations may be conducted simultaneously. The current used is taken from two 80-ampere-hour "chloride" cells charged from direct current mains through six 32-candle-power lamps. The storage battery current is distributed to the various circuits by porcelain double pole, double throw switches, which also permit the introduction of either or both the measuring instruments into any or all of the four circuits.



ELECTROLYTIC SWITCHBOARD.

The volt and ampere meters, scaled respectively from 1 to 15 and 1 to 10, are of the Weston soft iron, dead heat type, graduated in divisions of one-fifth, but easily readable to one-twentieth.

Each circuit is provided with a simple though efficient rheostat, controlling the current by steps of .01 of one ampere. An oak disc has been subtituted for the usual metallic rheostat arm. On the circumference is a groove in which is laid a spirally wound wire of proper resistance. One end of the wire is lead to the central bearing of the disc, thus forming one terminal. The other end is open, contact being made by means of a spring connection infringing on the circumference as the disc is rotated to vary the resistance

A special effort was made to devise a handy form of electrode holder, particularly as regards that of the cathode. Rotating anodes, for special reasons, were not wanted in this case, otherwise they might with advantage have been furnished. Although operated under low voltage, the switchboard is as thoroughly protected electrically as though subject at all times to service potentials.

DISTILLATION OF TURPENTINE BY ELECTRICITY.*

By F. T. Snyder.

Pine woods contain a series of volatile hydro-carbons having boiling points varying from 130° C. to 250° C. A mixture of these, including the groups which boil between 155° C. and 170° C., forms what is commercially known as turpentine. The principal constituent of this turpentine is pinene, with a boiling point of 155° to 156° C.

The process of obtaining turpentine from wood by distillation is an extractive one, in that the turpentine exists in the wood substantially in the form in which it is obtained, and is not a product of decomposition at the time of extraction. At 175° C., the pinene of the turpentine begins to break up into a mixture of lighter and heavier hydro-carbons, the decomposition being substantially complete at 270° C. It is, therefore, necessary to distill turpentine within relatively narrow temperature limits. If the wood from which the turpentine is distilled is not heated enough, part of the turpentine will be left in the wood. If it is heated too hot, part of the turpentine produced will be destroyed. Many of the products formed in breaking up turpentine have strong odors, and a small percentage materially affects the selling price of the turpentine produced, as the smell nauseates the painter using the turpentine. It requires a certain drop of temperature to cause the heat needed to flow from the exterior to the center of a turpentine retort, and this further reduces the narrow range of temperature available.

It has been known for many years that the fir wood of the North Pacific Coast contains a considerable quantity of turpentine, and efforts had been made to utilize it as a basis for the commercial production of turpentine. The principal difficulties encountered were those inherent in the close regulation of temperature necessary. Some years ago the obvious possibility of close temperature regulation obtainable with heat from electricity suggested the use of heat from electricity in the distillation of turpentine from this fir wood. At Vancouver, British Columbia, a considerable supply of waste fir wood was available, in the form of saw-mill refuse, and electricity from waterpower was available at a low cost. An experimental electric turpentine plant, with a capacity of one-sixteenth of a cord, was erected and tested, and subsequently reported upon by Dr. T. H. Bray, of the Massachusetts Institute of Technology. As a result of Dr. Bray's report, a commercial plant, with a capacity of three cords per day, was erected, and has been in operation at Vancouver since July, 1907.

The wood supply for this plant is brought in by barge, from neighboring saw-mills, and landed at a dock adjoining the plant. On this dock the wood is filled into cans, which are wheeled into the plant, picked up by an overhead crane (Fig. 1), and dropped into a brick retort, forming one of a group which are placed together to reduce radiation. The top of the can forms a flange, which dips into a groove around the top of the retort, filled with tar, forming a gas seal when the can is in the retort. Electricity at 110 volts is carried through wrought-iron strips threaded through the brickwork on each side of each retort. The current supply for each retort is controlled by a switchboard of ordinary type, which also holds the direct-reading pyrometers, one of which registers the temperature at the outside of the can, and one the temperature at the center of the can, showing the maximum and minimum temperature conditions in the can. The leads of these pyrometers end in flexible extensions on the top of the retorts, which can be changed from can to can (Fig. 2).

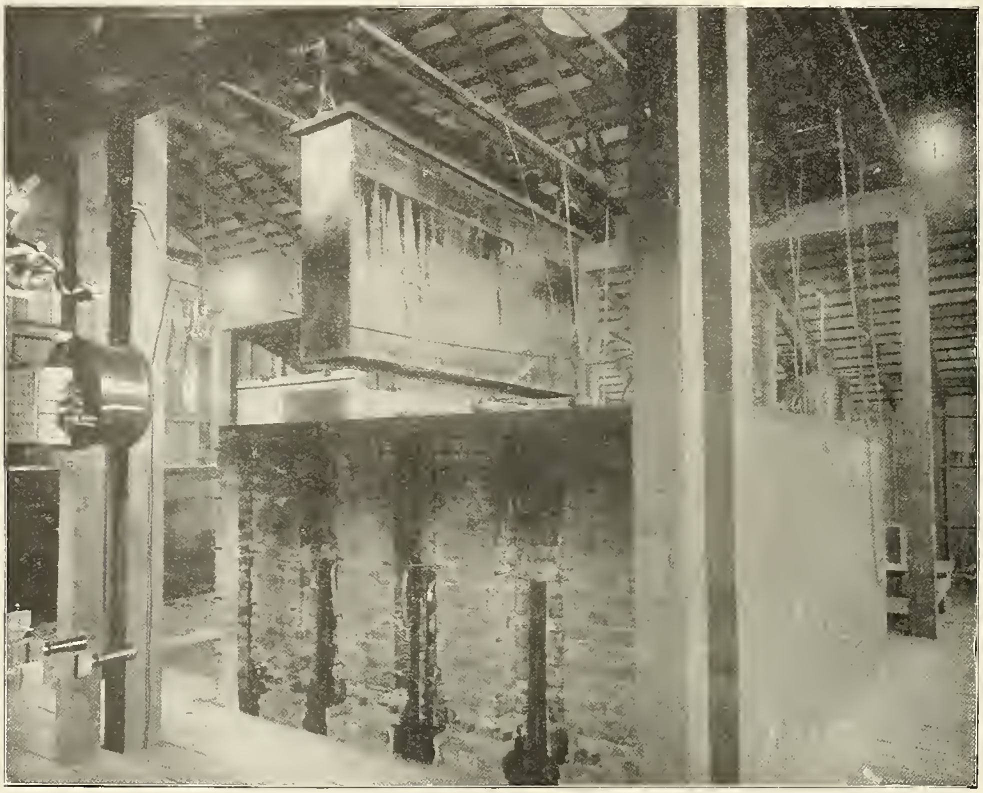


FIG. 1. DISTILLATION OF TURPENTINE BY ELECTRICITY.—RECEPTACLE CONTAINING WOOD BEING PLACED INTO RETORT.

The turpentine vapor is taken from the retort through a removable copper outlet pipe. This outlet pipe leads to a condenser (Fig. 3), which consists of an upright copper pipe, down which a spray of water is passed through the ascending turpentine vapor, and which terminates in a tank at the bottom. The tank serves as a separator for the condensed turpentine and water, the turpentine readily floating to the top of the water. The excess

*Paper read at Albany meeting of American Electrochemical Society. For the illustrations we are indebted to the courtesy of the Western Electrician of Chicago.

water from the spray is withdrawn from the bottom of the tank, and the turpentine taken off from the top of the tank into a storage system.

The brickwork of the retort, when a can newly filled with wood is put in it, is about 250° C. The cold can rapidly absorbs heat from this brickwork, the temperature of the brickwork being

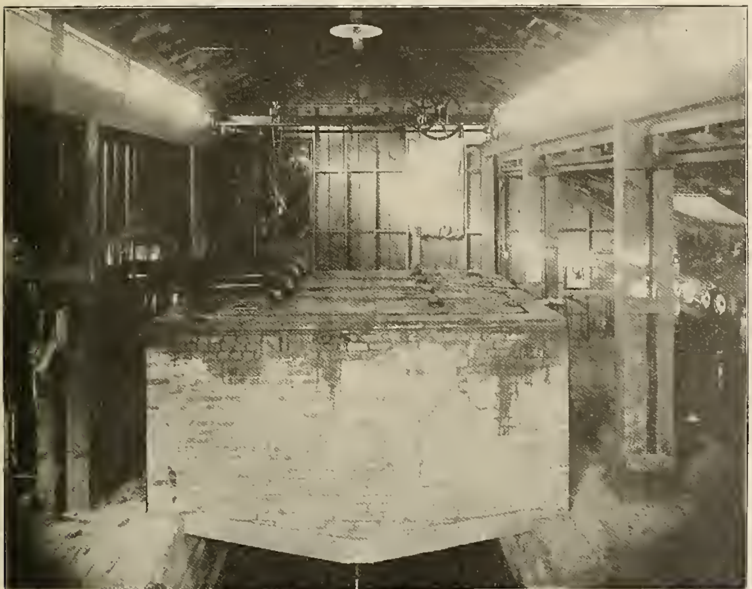


FIG. 2. VIEW SHOWING CANS IN RETORT. TURPENTINE VAPOR PASSES OFF THROUGH OUTLET PIPES SHOWN.

kept up by a current of 400 amperes, which is put through the resistance strips for about two hours. During this time the temperature at the outside of the can rises from 75° to 130° C., at which turpentine begins to come off, and at which time the center of the can is at 45° C. The current is then shut off, and the temperature of the can slowly rises by absorption of heat from the brickwork for two hours longer, when the temperature has reached 150° C. on the outside of the can and 205° C. in the center of the can, and the turpentine has been substantially all removed. In practice, it is found that from 90 to 95 per cent of the turpentine in the wood, as determined by analysis, is removed during this interval. While the turpentine is coming off, the pitch in the wood melts and runs down to the bottom of the can and out through perforations, and is collected in the bottom of the retort, from which it is drawn off, at the end of the run, into the barrels in which it is shipped.

It will be noted that the temperature of the interior of the can at the end of the turpentine run is hotter than the outside. This is due to the heat which is beginning to be liberated by the decomposition of the hydro-carbons in the wood. At this point the can is lifted by the overhead crane from the turpentine retort and put into the adjoining retort, a new can of raw wood taking its place in the turpentine retort. In its new position the original can of wood, from which the turpentine has been extracted, is connected up by another copper outlet pipe to the adjacent condenser. This change of retort and piping keeps the turpentine condenser and piping from being fouled by tar oil or tar products.

Due to the continued decomposition of the wood, the temperature steadily rises without further use of electricity, and the resulting decomposition gives a product known commercially as "tar oil" and which comes off as vapor and is condensed. The other product of this decomposition is wood tar, which trickles down as the rosin did in the turpentine retort, and is collected in the bottom of the tar retort. It is found in practice that this tar tends to break up at the final temperature of the tar retort, and it is consequently drawn off continuously, during the tar run, into the barrels into which it is to be shipped.

At the end of three hours of the tar run, the temperature in the center of the can has risen to 375 degrees Centigrade, and tar oil and tar stop coming off. The can is then lifted out and stood on a sand floor, which makes an air seal with the lower edges of the can and protects from combustion the contents of the can, which now consists of charcoal. When the can and its charcoal contents are cool, which takes about three hours, the perforated bottom of the can is tripped and the can lifted, allowing the charcoal to fall out. This charcoal is then put in sacks as required by the trade which consumes it.

Five products are produced from the wood—turpentine and rosin in the turpentine retort, tar oil and tar in the tar retort, and a residual product of charcoal. The amount and kinds of product derived from any supply of wood depend on the character of the wood. The following will indicate the results which are being secured from the British Columbia coast fir per 1,000 pounds of wood:

Turpentine	6.7	gallons
Rosin	168	pounds
Tar Oil	5.1	gallons
Tar	68	pounds
Charcoal	323	pounds

It may be noted that this charcoal being retort charcoal and cooled out of contact with air, is tough and suitable for special purposes. The amount of wood held by a can varies with the quality of the wood, but averages at Vancouver about 1,000 pounds. The electricity used per can is about 90 kilowatt-hours, and costs, at Vancouver, 18 cents per can of wood.

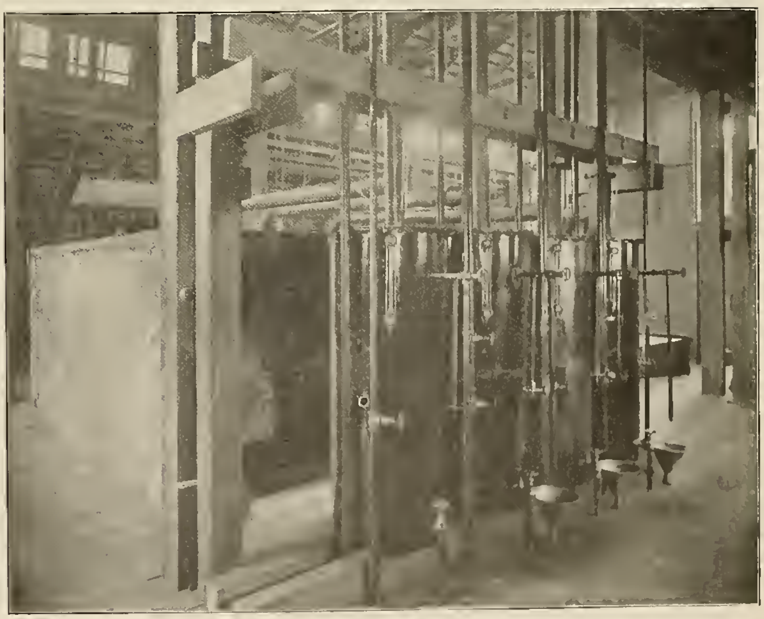


FIG. 3. VIEW SHOWING TURPENTINE CONDENSERS WHICH RECEIVE THE VAPOR FROM RECEPTACLES IN RETORT.

The plant is operated by one man on each shift, there being two 12-hour shifts per day. When the wood is large, an extra man is employed on the day shift to split it.

EVOLUTION OF CAST IRON PIPE.*

(Concluded.)

Cement Joints Made in Winter.—In the eastern part of the country where more or less cold and freezing weather is experienced in the winter time good results in laying pipe with cement joints in winter are difficult to obtain. They can be secured, however, and the experience of one of our friends in putting down a main 8½ miles in length, partly of 16-inch and partly of 20-inch cast iron bell and spigot pipe, is of interest. This line runs in part through open country. He writes: "A large part of the work was done during the winter of 1903-1904, which was an unusually severe one, the thermometer a number of times during January and February going below zero. The thermometer averaged below freezing from the middle of December until some time in March, so that there was scarcely any weather which would have been considered suitable for making cement joints. In laying this line, the joints were tested under three pounds pressure between thirty-six and forty-eight hours after they were made. Between October 30th and December 14th, of the 1,289 joints that were made, 30 were found leaking and were re-made. Between December 15th and March 8th, 2,352 joints were made, and out of these, 225 were found leaking. There were 3,641 joints on the line, and the total number re-made was 255. We have been over the line this year and have found it in almost perf^ct condition." As this was the first pipe put down with cement joints at this plant, it was necessary at the same time to train the men. Hence the loss in joints between October 30th and December 14th mainly resulted from the fact that the men were learning. The loss between December 15th and March 8th was largely due to freezing. Had the line been laid in seasonable weather, comparatively few leaks would have developed. The freezing of the joints occurred in spite of every effort to keep them covered and warm until set, but as the pipe were tested in the open trench, the leaks were easily located and re-made, and the line is now most satisfactory. The climatic conditions along the Pacific Coast are almost ideal for the making of cement joints and if an ordinary lead joint were made every four to six lengths, possibly there would be sufficient elasticity in a line of pipe to take care of the vibration due to an earthquake of ordinary severity. The City of Santa Ana in Southern California is using cement for joints with good success.

High vs. Low Pressure Gas Mains.—Within recent years, some engineers have sought economy in using comparatively small diameter wrought iron or steel mains under relatively high pressure, for carrying gas from works to a center of distribution at some distance. These mains will not prove as durable as cast iron pipe, and it is a serious question whether a larger diameter cast iron main under low pressure will not in the long run prove the less costly. While the low-pressure main may involve a greater first cost, the high-pressure line usually carries a heavy daily charge for pumping and maintenance, added to which is often a material loss in candle power. These are factors which it is our impression have not been as carefully estimated as their importance warranted.

Gas Mains with Turned and Bored Joints.—The foregoing may be said to outline general practice for lead and cement joint cast iron gas mains in the United States. Abroad, however, the practice varies, and many prominent users prefer the turned and bored joint. One prominent gas engineer in London writes: "We continue the use of gas pipe with turned and bored joints." Another: "We do not use turned and bored joints; we prefer the ordinary spigot and socket joint made with lead rings run into the socket, as being a more flexible connection, and one which can be more easily made sound by setting up, should any subsidence occur, which has tended in any way to loosen the joint." Evidently "doctors disagree." It is nevertheless true that the turned and bored joint has been adopted with satisfaction in many important gas plants in England and other countries, while we may say it is not used at all in the United States. Our inquiries as to gas leakage in cast iron pipe having turned and bored joints have failed to bring definite response in figures or percentages, the usual statement being that the joint leakage is very small. For those who prefer an iron-to-iron joint, the turned and bored pipe are offered as being of the most commonly used and simplest type, avoiding use of bolts. These pipe are also cast vertically in dry sand and finished in lengths to lay 12 feet, our standard specifications being followed as far as they apply to pipe of this design. All bells and spigots are machined to template, insuring close-fitting iron-to-iron joints easily laid. The turned and bored joints for gas mains should only be used in districts where streets are straight and the soil is very good and firm, as any subsidence or movement may lead to fracture and consequent large and perhaps dangerous leakage. There may be reasons for adopting the turned and bored joint of which we are not advised, but considering the excellent results obtained with the bell and spigot joint in the United States and apparently abroad, we agree with still another London engineer who writes: "I do not consider that the turned and bored joint offers any advantage over the lead joint generally used for gas mains, unless it be in the speed and facility with which they may be laid." With turned and bored pipe, special castings with bells all around are usually supplied, and into these bells a cut pipe is perhaps as often inserted as is the turned spigot.

LOW PRESSURE GAS MAIN.

Cast Iron vs. Riveted Steel Pipe.—The question of the life of cast iron as compared with wrought iron or steel-riveted pipe is best answered by comparison. In 1905, at Portland, Oregon, the contract for cast iron pipe was awarded at a very marked increase in the total cost, as compared with tenders for steel. Owing to the distance from the foundries the cost of freighting became a most important factor, because of the great difference in weight, which naturally favored the lighter or steel pipe. This award of the contract for cast iron pipe, was not made until after a very careful investigation on the part of the engineer, D. D. Clarke, Esq., who, during the fall of 1905, visited some fifteen cities to confer with the officials in charge of water supply, as to their experience with riveted steel mains and to ascertain for himself what he could as to their condition.

*Contributed by R. W. Martindale.

During 1893 and 1894, the city of Rochester, N. Y., put down a 38-inch steel pipe conduit made up of steel plates, 1/4-inch and 3/8-inch metal. This line runs from their overflow No. 1, about two and one-quarter miles north of Hemlock Lake, to Mount Hope reservoir, a distance of twenty-six miles. The annual report of the city of Rochester for the year 1901 shows that as early as the year 1900 leaks in the line were discovered, and found due to corrosion of the steel plates, and that in January, 1901, other leaks began to develop. Later reports show that during the year, in seven separate excavations, fifteen holes, 1/16 inch to 3/4 inch in diameter, were found, due to corrosion, and that more or less tuberculation was present along the joints and around the rivet heads. One sheet alone was found to contain more than five hundred pits about 1/8 inch in diameter by 1/16 inch deep. A careful examination of the interior of this steel pipe indicated that the cause of the corrosion was not confined to the presence of certain active elements in the soil. Later reports indicate that during 1902 further investigation showed that a great many more leaks had developed. The reports of the city of Rochester for the years 1901 and 1902 contain interesting notes regarding the investigations made by eminent engineers. Attention is particularly directed to the report of Professor F. L. Kortwright of West Virginia University. The experience of Rochester is interesting along the line of investigation as to the causes of corrosion of steel pipe as will be seen by any one interested enough to read in full the report of Professor Kortwright. It the case of this line of pipe every care was taken in the selection of the material.

The coating of the pipe was prepared after a formula by Professor Emil Kuichling and applied in a most careful and approved manner.

As a general proposition, it seems to be now conceded that on an average steel rusts at least 25 per cent more rapidly than cast iron; and when the relative thicknesses of riveted-steel and cast iron pipe are considered, it is readily seen that cast iron pipe will prove by far the more permanent. Then, again, the increased friction in riveted-steel pipe reduces by 10 to 20 per cent the flow of water, as compared with cast iron pipe of the same diameter.

POSSIBILITES FOR TURPENTINE IN NORTHWEST.

L. W. Hawley, expert on wood distillation for the Forest Service, has just left Washington, for Oregon, Washington, Montana, and Idaho, to investigate the possibilities of a future turpentine industry in the northwestern portion of the United States.

Mr. Hawley has taken with him a small distillation apparatus, which he will set up at various places in these States, distilling the different woods to determine their value in the production of turpentine. In this manner an accurate idea of the yield of extracts from the various woods can be obtained, and samples of the material will be sent to Washington for analysis and estimation of its value for use in paints, varnishes, and other naval stores.

There are at the present time in the Northwest, several wood-distilling plants, which are producing various grades of turpentine, wood-preserving oils, and materials of a similar nature. It is believed that a careful study of existing conditions in this section will yield results which will give an accurate idea of the possibility of utilizing the enormous quantity of sawmill refuse now going to waste.

WATER POWER.

In his address at the conference on the conservation of natural resources, H. St. Clair Putnam said:

"Where power is derived from water, winds and tides, only energy otherwise wasted is used. The energy thus extracted is added to our assets instead of being a permanent loss as is the case with the combustion of coal. In the aggregate the available water powers of the nation greatly exceed the present power requirements, but unless there is some curtailment in the rate of our development, our water-power resources will not of themselves solve the problem of our future supply of power. The power of Niagara Falls has been estimated, by Prof. W. C. Unwin, at 7,000,000 horse-power. A partial estimate of the water powers of the upper Mississippi River and tributaries places the available water power at about 2,000,000 horse-power. The southern Appalachian regions can furnish a minimum of nearly 3,000,000 horse-power. Both of these estimates can be greatly increased by including the use of regulation reservoirs and auxiliary steam plants. The water powers of New England are more fully developed than elsewhere in the country, though much remains yet to be done. In the Rocky Mountains and the far West there are immense water-power possibilities; in the State of Washington alone there are 3,000,000 horse-power available. It is probable that the water power in the United States exceeds 30,000,000 horse-power, and under certain assumptions as to storage reservoirs this amount can be increased to 150,000,000 horse-power or possibly more.

"Using the smaller figure of 30,000,000 horse-power as an illustration, to develop an equal amount of energy in our most modern steam-electric plants, would require the burning of nearly 225,000,000 tons of coal per annum, and in the average steam-engine plant, as now existing, more than 600,000,000 tons of coal, or 50 per cent in excess of the total coal production of the country in 1906. At an average price of $3 per ton, it would require the consumption of coal costing $1,800,000,000 to produce an equivalent power in steam plants of the present general type.

"During the past few years, there has been renewed interest in water powers on account of the practicability of their use for the generation of power, and the electrical transmission of this power to distant markets. The great hydro-electric development at Niagara was the first large enterprise of this character, and has demonstrated its practicability. The census of 1905 gives a partial list of long-distance hydro-electric plants developing power aggregating 600,000 horse-power, and this list can now be largely increased. Our most desirable water powers are being absorbed rapidly, and it becomes important, therefore, for us to take stock of our water resources and formulate plans for their control and proper utilization.

"In the improvements that have been made on navigable rivers, too little attention has been given to the development of the incidental water powers. On some waterways, as in several instances on the Mississippi, immense sums of money have been appropriated and expended on especially difficult portions of the river. If this money could have been made available in large amounts, instead of by driblets over periods of many years, water powers of great value could have been developed, and the navigation effectively and permanently improved. Unfortunately this has not been our policy. Too often the appropriations have been inadequate for carrying out the work as it should be done, and frequently the work has not followed any well-digested plan.

"With the data at hand, it is impossible to make an accurate estimate of the amount of power that can be developed incidentally to river navigation. A partial estimate of the power developed at existing Government locks and dams places the amount at 1,600,000 horse-power. This is based on

the mean low-water discharge for three months. This subject should receive careful consideration. Improvements in navigation should be made only after thorough study of the possibilities of power development. On the other hand, many water powers are on streams that are navigable, or are capable of canalization, and these streams should be developed for power purposes only after careful examination has been made of the possibilities of the stream forming a link in the system of inland waterways.

"The flow of water in many streams annually fluctuates between wide limits. The low-water periods limit the profitable water-power development and the high periods often cause disastrous floods. On most streams the average rate of flow for the year is many times the minimum flow. It is possible in some cases to utilize a flow approximating the average by constructing controlling reservoirs on the headwaters of the stream. Our Great Lakes form a natural reservoir of this character for the Niagara River. The upper Mississippi has great natural reservoirs which assist in regulating its flow, and which easily can be made very effective in its control. The notable floods of the Ohio River can be greatly reduced by the construction of controlling reservoirs on its headwaters, which will result in the saving of millions of dollars now annually wasted. On a stream which I recently investigated, the minimum flow furnishes but 200 horse-power. The construction of a storage reservoir increases the continuous twenty-four-hour power that can be utilized to 8,000 horse-power. If storage reservoirs could be constructed on the Susquehanna River, upon which a great water-power development is now in course of construction, so as to obtain a uniform flow throughout the year, the available power at this site would be increased from a minimum of 30,000 horse-power to 200,000 horse-power. While it is impracticable to construct reservoirs capable of holding back all flood waters, it is nevertheless certain that material gain would result from well-directed efforts along the lines suggested.

"In many cases water could be utilized for developing power on the headwaters of the streams without injury to the irrigation interests, as is illustrated by the excellent work now being done by the Reclamation Service. The development of water power will introduce another party whose self-interest dictates the use of every available method of preserving the volume of water supply, its continuity and regularity of flow.

"Where it is necessary to place a dam across a stream to develop power, the slack water so produced, with the addition of locks, renders otherwise impassable stretches of river available for navigation. Every water-power development is vitally interested in obtaining a uniform flow of water. This exactly meets the requirements of navigation. The approximate realization of regularity of flow can be attained only by the construction of headwater-regulating reservoirs and the preservation of our forests. Every water course that is improved for the production of power and for navigation produces, therefore, vigorous self-interested allies in the cause of forest preservation, headwater regulation, and the maintenance of conditions which are favorable to both interests.

"Heretofore, canals built for transportation purposes have not been used, to any great extent, for the development of power. In some cases this has been on account of the limited supply of water, but more frequently it has been due to the great difficulty experienced by the animals in towing boats against the rapid current produced in the canal by the flow of water to the water-wheels. With electric towing, the increase in the rate of current flow introduced by the development of water power on the canal is not a serious impediment to navigation.

"In addition to their reserve function in time of low water or flood, auxiliary steam plants and interconnected plants are valuable as insuring the continuity of power supply. If the lines are run overhead, as they must be for long-distance transmission in the present development of the art, all electric transmission plants are subject to occasional short interruptions due to storm, lightning, or malicious mischief. It is economical and desirable to tie together two or more plants, thus greatly increasing the reliability of service. If one plant or transmission line fails, the others can be pushed to take the load. From an engineering standpoint, and from the standpoint of the engineer as well as the power producer, this method of operation has great advantages.

"Power and transportation are the two great physical bases upon which modern industrial development rests. Without power, our methods of transportation must revert to a level with those existing in China. Up to the present time, while Nation and State have regulated, and in some degree aided, in the development of transportation, the power resources of the country have been utilized or wasted by the private individual and the corporation with little hindrance, and still less assistance from the constituted authorities. Next to individual enterprise, the most essential factor in the development of our national resources is wise governmental regulation, so applied as to insure the vigorous working of individual initiative, and at the same time prevent the waste by individuals of that which is vital to our national welfare, and to secure in the utilization of our natural resources the highest practicable degree of economy which scientific knowledge and engineering skill can attain."

THE RENTAL VALUE OF A POWER PLANT.

The rental value of a power plant, according to a paper by Chas. T. Main, depends upon its character and efficiency to produce power cheaply. The cost of producing power in small amounts is very much greater than in large amounts, and the amount which the lessee should pay may be obtained in comparison with the cost of producing the amount of power required with a reasonably efficient plant with steam power or by some other means. Thus, supposing the power to be rented is water-power and plant, its value can be determined by estimating the cost of producing a uniform power by water-power, supplemented by steam power if necessary, and comparing the cost of producing the same amount of power by steam power alone, in each case adding such charges as the lessee is to assume. The difference, if in favor of the water-power, will represent the value of the power for the length of time the estimated cost covered.

If the power plant be a steam plant, it is possible that it has no rental value; that is, it may be so wasteful that it would pay to replace or change parts of it to bring it into an economical state. If it is an economical plant, and is to be run by the lessee, he should pay such rent as will cover depreciation and a fair rate of interest, and assume repairs, insurance, and taxes, or pay enough rent to cover them. In the same way, if power is sold the lessee, the proper amount to pay per horse-power per year will vary with the amount which he requires.

As the amounts of power grow smaller, the cost of producing it is larger, and therefore a larger price per horse-power per year must be paid. The charges for small amounts of power seem to vary from $50 to $100 per horse-power per year; but each case should receive its careful attention.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

RHEOSTATS.

"Compensaic" auto-transformer with knife-switch designed to furnish 14, 40, or 60 Amp. to the lamp of moving picture machine outfits, 110 or 220 volts, A. C. Approved April 13, 1908. Manufactured by

Fort Wayne Electric Works, Fort Wayne, Ind.

ROSETTES, FUSELESS.

Two-piece fuseless rosette, cleat type, 3 A., 250 V., Cat. No. 310. Approved April 13, 1908. Manufactured by

E. H. Freeman Electric Co., Trenton, N. J.

SOCKETS, STANDARD.

Bryant Brass Shell, key and keyless. Cat. Nos. 9,386, 9,392, 50,760, 50,768, 99,386, 99,392, 43,389, 43,390. Fixture sockets, 1,317 to 1,320, inclusive; "Security Snap," Nos. 44,-147 to 44,152, inclusive, and 44,814, 44,815. "New Wrinkle," Nos. 59,480 to 59,487, inclusive. Also above types with shade holders attached. Twin socket, Cat. No. 46,750, for use on fixtures only. Approved April 9, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SOCKETS, STANDARD.

"Perkins" brass shell, key and keyless, Cat. Nos. 9,386P, 9,392P, 50,760P, 50,768P, 59,480P to 59,487P, inclusive. Also above type with shade holders attached. Approved April 13, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SOCKETS, WEATHERPROOF.

P. & S. Weatherproof Sockets, 3 A., 250 V. Pendant style, porcelain shell, Cat. No. 116. Composition shell, Cat. Nos. 60,666 and 60,666A. Bracket style, porcelain shell, Cat. Nos. 0-116½ and 116½. Pendant style, for festoon work, Cat. No. 418. Approved April 13, 1908. Manufactured by

Pass & Seymour, Solway, N. Y.

LAMP GUARDS.

"Standard" adjustable lamp guard, with or without spiral safety cushion. Approved Apr. 28, 1908. Manufactured by

Standard Wire Co., New Castle, Pa.

CONDUIT, LINED.

Approved Apr. 24, 1908. Manufactured by

Sprague Electric Co., 527 W. 34th St., New York, N. Y.

CONDUIT, UNLINED.

"Loricated" and "Galvaduct." Approved Apr. 27, 1908. Manufactured by

Conduit Company, Ltd., Toronto, Ontario, Canada.

FUSES, CARTRIDGE ENCLOSED.

"Arkless," National Electric Code Standard. All capacities, 250 and 600 volts. Approved Apr. 29, 1908. Manufactured by

The Detroit Fuse & Mfg. Co., 40-46 Champlain St., Detroit, Mich.

LAMP GUARD.

"Benjamin" portable lamp guard, 16 C. P., 250 V., Cat. No. 160-P. Wooden handle with fibre cage. Approved for use only in dry places. Approved Apr. 28, 1908. Manufactured by

Benjamin Elec. Co., 42 W. Jackson Blvd., Chicago, Ill.

RECEPTACLES, STANDARD.

"Tregonning" sign receptacles, Cat. Nos. 300, 301, 302, 3A, 250V. Approved Apr. 24, 1908. Manufactured by

Tregonning Electrical Mfg. Co., 224 High Ave., S. E., Cleveland, Ohio.

MISCELLANEOUS.

Motor driven cash register for 110 and 220 volts, A. C. or D. C. (Maximum current, 3A.) Motor mounted on register frame and enclosed in register case. Connection to supply circuits by means of approved reinforced portable cord and approved attachment plug. Approved May 14, 1908. Manufactured by

The National Cash Register Co., Dayton, Ohio.

RECEPTACLES, STANDARD.

"Paiste" Receptacles, 3A, 250 V. Sign receptacles, Cat. Nos. 1700, 40488 and 46749. Cleat type, Cat. Nos. 9402, 9403, 50715 and 11221. Moulding type, Cat. Nos. 47567 and 47568. Approved May 11, 1908. Manufactured by

H. T. Paiste Company, 32d and Arch Sts., Philadelphia, Pa.

"Paiste" Wall Sockets, mounted on PK or KW link fuse rosette bases, 2A, 125 V. Brass shell, key or keyless. Cleat types, Cat. Nos. 50730, 50733, 34194, 34197. Concealed types, Cat. Nos. 50729, 50732, 34193, 34196. Porcelain shell, Cat. Nos. 38135, 38136, 38394, 38395. Also above types with shade holders attached. Approved May 12, 1908. Manufactured by

H. T. Paiste Company, 32d and Arch Sts., Philadelphia, Pa.

SOCKETS, STANDARD.

"Perkins" Brass Shell, key and keyless, Cat. Nos. 9386P, 9392P, 50760P, 50768P. "New Wrinkle," 59480P to 59487P, inclusive. Also above types with shade holders attached. Approved May 8, 1908. Manufactured by

The Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SOCKETS, WEATHERPROOF.

"Cole" Composition, pendant. Cat. No. 60666, black or brown finish, 3A 250V. Approved May 14, 1908. Manufactured by

Henry Cole & Co., Boston, Mass.

SWITCHES, DOOR.

3A, 250V. Approved May 9, 1908, for use when mounted in approved switch box. Manufactured by

Hart & Hegeman Mfg. Co., 342 Capitol Ave., Hartford, Conn.

3A, 250V. Approved May 9, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SWITCHES, KNIFE.

"American" Types A and B; 125, 250 and 600 volts. All capacities, with or without extensions for cartridge fuses. Approved May 7, 1908. Manufactured by

American Electric Switch Co., Springfield, Mass.

SWITCHES, PUSHBUTTON, FLUSH.

Single pole, 3-way and 4-point; 10A, 125V; 5A, 250V. Double pole, 10A, 250V. Approved May 13, 1908. Manufactured by

C. S. Knowles, 7 Arch St., Boston, Mass.

SWITCH BOXES.

"Fancleve" cast iron switch boxes. For metal conduit. Cat. Nos. 351, 501. For flexible tubing, Cat. No. 651. Approved May 5, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

WIRES, RUBBER COVERED.

Marking: Two red threads woven into braid, crossing each other. Approved May 11, 1908. Manufactured by

Acme Rubber Mfg. Co., Trenton, N. J.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager
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Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription 3.50.$ Foreign subscription, $4.00.
Subscriptions cannot be begun with back numbers.
Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

Vol. XX JUNE 6, 1908 No. 23

EDITORIAL.

RENEWED CONFIDENCE.

A sudden freshet in one of the feeders of a great reservoir finds the weak place in the restraining dam, and the water conserved for power purposes thus becomes a destructive flood. If the structure be well built, on a firm foundation, with sufficient outfall, the damage will be limited to that done by the head of water above the break. But even this is often so great that whole villages and towns are swept away and their inhabitants ruined, thankful to be alive. Fear and anxiety so blind them that they do not see beyond the present moment, nor realize that with renewed hope this calamity may eventually be a benefit. For the loam filched from fertile fields is deposited on new ground as the flood subsides. Old barriers to progress are swept away, leaving a smoother, deeper channel. Unknown placer mines may be uncovered on the land stripped of its soil and its owner enriched thereby. Investigation shows also that the greater part of the strong dam still stands unharmed, as a basis for a bigger power-plant. In time the scars become healed and the community more prosperous than before, profiting by the experience gained in the disaster.

Thus it seems with regard to the recent break in the financial structure, occasioned by speculative excesses. Broken public confidence occasioned a flood that engulfed business stability in its whirling eddies. Houses with insecure foundations were overthrown, and some of the strongest tottered. Thousands of men were thrown out of employment. During the past winter the distress was widespread, but with the spring came hope, and with hope, confidence. The bulwark of our natural resources was unimpaired, and on it as a foundation, a new financial structure has been reared. Contrary to the hopes of even the most sanguine, the recovery of financial integrity has been more rapid than the decline following the discovery of its former unsoundness. Money is once again flowing in its normal channels. Deferred dividends are being paid, loans are being renewed, bank clearings are increasing, and those out of employment are being sought to take up suspended work. New vitality has been infused during the period of enforced rest, and men are now better prepared for the future. Engineering progress has continued during business depression, and methods neglected in busier times have been successfully developed during this interval.

The indicator card of progress can always be determined from the state of the iron market and from power development. They are the barometers that foretell the advent of adversity or prosperity. The decline in the demand and production of iron, beginning late last October, was simultaneous with the financial panic, and their continued depression have been coincident. Consequently the announcement that the Illinois Central R. R. Co. has placed a contract for 52,000 tons of steel rails, costing $1,456,000, will stimulate the return of prosperity. Steel mills will reopen, and it is said that immediate work is to be given to 2,000 skilled men who have been idle for some time past. This is but one of several similar significant announcements.

The power possibilities are no less promising, especially since the needed check on heedless waste has been universally suggested by the Conservation Conference at Washington. In response to the summons of the President, forty-one Governors met together with the leaders of representative bodies of trade, agriculture, engineering, and financial interests. While such a meeting possesses no legislative power, yet it has awakened the people of the Nation to a realization of the danger that threatens them, and this public opinion will undoubtedly re-act upon Congress, so that we may hope for a Federal commission on the conservation of the natural resources that will advise and confer with the various state commissions. The consequent uniformity of national and state laws cannot but prove a benefit to the power industry, at present amounting to over thirty million horsepower.

Misdirected energy, whether of power, water, money, or human vitality, only retards progress, and the sooner the necessity for its centralized direction becomes recognized, the more rapid will be the rate of man's work. Thus profiting by past mistakes and courageously expressing our faith in the ultimate outcome, success will reward our efforts.

EXAMINATION FOR ELECTRICAL AND MECHANICAL DRAFTSMAN.

The United States Civil Service Commission announces an examination on July 22-23-24, 1908, to secure eligibles from which to make certification to fill one or more vacancies in the position of electrical engineer and mechanical draftsman, at an entrance salary of from $100 to $200 per month, in the Reclamation Service, and vacancies requiring similar qualifications as they may occur. Eligibles from this examination may be appointed as electrical engineers or assistants for the design, installation, or operation of hydro-electric and steam power plants in the West, or as mechanical draftsmen for office work and drafting in connection with preparation of plans. The examination will consist of: Mathematics, applied mechanics, mechanics of materials (pure mathematics through calculus, computations of stresses in metal beams, structures, etc., tensile and compressive strength of concrete, etc.); hydraulics (computation of horse-power, plan of connection, water-wheel design, arrangement of pipe, friction losses, discharge of orifices, velocity head, etc.); theory and practice of electrical engineering (design, construction, and operation of modern alternating-current power transmission plants); steam turbines and engines; drawing and design (layout of hydro-electric and steam-power plant, buildings and machinery); training and experience (rated on application). Competitors may also be examined in one or more of the following-named optional subjects: 1. Centrifugal pumps (design and installation); 2. Turbine water wheels (design and installation); 3. Gas engines. These optional subjects will be given on the third day. Two hours will be allowed for each optional subject. Applicants must indicate in answer to question 1 of application Form 1312 which, if any, of the optionals named above they desire to take.

EXAMINATION FOR FIRST-CLASS STEAM ENGINEER.

The United States Civil Service Commission announces an examination on July 1, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of assistant engineer, at $1,400 per annum, in the office of the Secretary of Agriculture, and vacancies requiring similar qualifications as they may occur.

Consul Frank S. Hannah reports that in some tests made in March in a factory at Magdeburg-Buckau, Germany, by an expert from Darmstadt, a new world record was established for "locomobiles" in the production of a maximum amount of steam by a minimum consumption of coal. The engine used to make the experiments was a newly constructed 100-horsepower patent steam "locomobile" (traction or stationary engine), with piston-valve distribution and use of superheated steam. The tests established that for each unit of horsepower, 8.66 pounds of steam and 1.042 pounds of coal were consumed per hour.

PERSONAL.

A. Neugard, of the Henry Neugard Company of Chicago, has been in San Francisco during the past week.

M. C. Crawley, electrical engineer for the Union Oil Co., has been in San Francisco during the past week.

Geo. H. Scoville of the Dean Electric Co., went South after his return to San Francisco from the Northwest.

C. H. Pennoyer, Pacific Coast Manager National Conduit and Cable Co., has been seriously ill, due to blood poisoning after an operation.

G. C. Pierce has been renewing friendships among former associates in the electrical trade on the Coast. While on health and pleasure bent, he is representing the McGuire-Cummings Mfg. Co., of Chicago.

TRADE CATALOGUES.

"Vox Populi," from the Wagner Electric Manufacturing Company, of St. Louis, is a neat testimonial booklet, detailing experiences with Wagner single phase motors for all classes of service.

The Sprague Electric Company is sending out a folder describing its new Stamped Steel Octagon Box No. 6250. This box is a departure from former practices in the stamped steel line, and undoubtedly will be welcomed by the electrical trade. Folder No. 431 tells the story concisely, and will be sent to any one requesting it.

The Sprague Electric Company is sending out a series of attractive blotters to advertise its well known and popular electric fans. This company has a line of direct and alternating current fans adapted for all requirements—electric fans for everybody everywhere. Catalogue No. 317 describes the fans, and may be obtained by addressing the company.

Crocker-Wheeler Co. of Ampere, N. J., send Bulletins Nos. 96, 101, 102, 103 and 104. No. 96 is devoted to alternating current, switchboard panels for two phase, four wire and single phase ungrounded systems. No. 101 illustrates and describes Form D, machine belt type, direct current, motors 50 to 275 horsepower, and generators 45 to 225 kilowatt. Alternating current switchboard panels for two phase, four wire, and three phase three wire ungrounded systems, 1150 to 2300 volts are listed in No. 102. No. 103 is a reprinted article on "The Sanitary District of Chicago's Hydroelectric Development on the Chicago Drainage Canal." No. 104 details by picture and text the excellent features of Crocker-Wheeler's direct current railway generators.

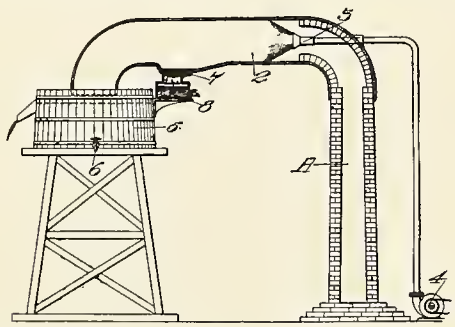
ERRATA.

In the article on "Inductive Interference With Telephone Circuits in Proximity to High Potential Transmission Lines," issue of May 23rd, page 318, column 2, line 39, 60000 should be $\frac{60000}{\sqrt{3}}$; on page 320, column 2, line 24, the word manufac- [illegible] should be microfarad.

PATENTS

APPARATUS FOR CONDENSING FUMES AND GASES. 888,119. George C. Richards, Berkeley, Cal., assignor to Richards Gas & Fume Condenser Company, Oakland, Cal.

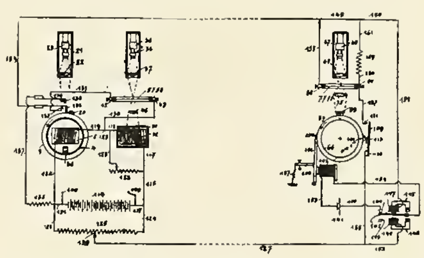
An apparatus for condensing vapors, said apparatus having in combination a vertical smoke-stack, a horizontal



pipe extension of the stack, said extension having a bend connecting with the top of the stack and said bend having double walls for protecting the bend from intense heat, a hydraulic jet entering the extension and discharging at a point in advance of the bend, and a tank into which the opposite end of the extension discharges.

AUTOMATIC PHOTO-TELEGRAPH. 888,098. Arthur Korn, Munich, Germany.

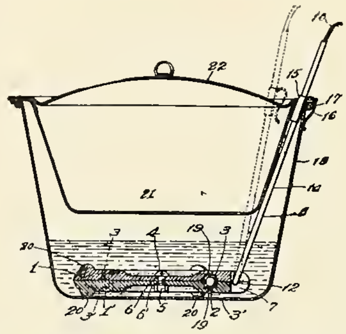
In a photo-telegraphic system, the combination with a circuit at the transmitting station and comprising two selenium cells in series, of means for exposing one of said two selenium cells to the light passing from a constant source of light through a moving point on a transparent original, a sensitive film or the like at the receiving station, a shunt line leading from said circuit at a point between the two



selenium cells to the receiving station and back to the circuit at a point outside the two selenium cells, means inserted in said shunt line and adapted to control the exposure of the other selenium cell to a constant source of light in accordance with that of the first selenium cell, and means inserted in said shunt line and adapted to control the exposure of a moving point on said sensitive film or the like to a constant source of light in accordance with that of the first selenium cell.

ELECTRIC HEATER AND COOKER. 887,923. Ella M. Crandall, Dolgeville, Cal.

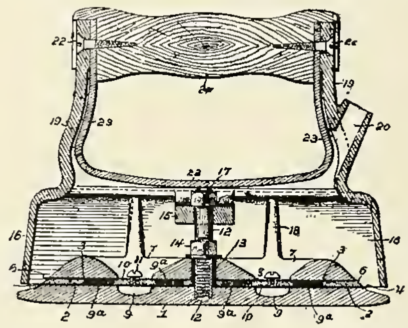
Two complementary insulating plates each recessed on one side to receive a heating element and each provided with parallel slots in the peripheres of the plates and communicating with the ends of the grooves, insulated terminals in said slots having angularly-bent ends in said



grooves, a heating element in the recesses of said plates, and means for fastening the plates together.

ELECTRIC HEATER. 887,871. Clarence L. Taylor, Alliance, Ohio.

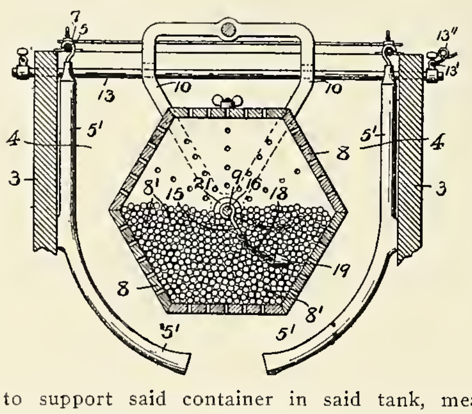
An electric heater, comprising three super-imposed plates insulated from each other, the intermediate plate having a series of openings, resistance coils disposed in



the openings in the intermediate plate and having their outer convolutions in electrical contact with said plate, and means for connecting the terminals of leading-in wires to the inner convolutions of said coils, whereby said coils are included in series with each other.

ELECTROPLATING APPARATUS. 888,068. John T. Daniels, Newark, N. J., assignor to The Hanson & Van Winkle Company.

In an electroplating apparatus a tank adapted to contain an electroplating solution, a rotatable container,



means to support said container in said tank, means to rotate said container, an anode, means to support said anode within said tank, a cathode element comprising a flexible portion and, at its free end, a part heavier than said portion, and means to support said cathode within said container.

INDUSTRIAL

WAGNER ELECTRIC GROWTH.

In 1890, two young electrical engineers, Mr. H. A. Wagner and Mr. Ferd. Schwedtmann, appreciating the fact that at that time there was no satisfactory alternating current fan motor on the market, began in a small shop, in a very small way, the manufacture of desk fans. Strict attention to business and a careful conservation of their energies, and good fortune in getting the repair work of a large central station,

The company was successful; made money from the start, and received great impetus from the proper organization of factory and selling forces. The results of the work in the Experimental Department here began to make themselves felt, in the introduction of the first successful single phase motor ever put upon the market. The success with which this motor was received made necessary the further addition to these buildings, as shown, in 1900.

In 1896 and 1897, the company further extended its line

WAGNER FACTORY 1890.

WAGNER FACTORY 1891.

WAGNER FACTORY 1893.

WAGNER FACTORY 1896

WAGNER FACTORY 1900.

attracted other capital toward them. These two young men conducted their fan business in a small store, cut of which is shown herewith. After having been in business a year, it very soon became apparent that additional capital was desirable; this was forthcoming, and the plant shown in 1891 was the result, the Wagner Electric Manufacturing Co. being then incorporated.

It was repairing transformers that first showed the Wagner Company the faults of other transformer manufacturers, and how to remedy them. Its research and development of this line of apparatus led it into new lines of thought and new forms of construction, both mechanically and electrically. This naturally led up to transformers of their own design, and the introduction of the Transformer Department rapidly used up all available space in this 1891, three-story structure, which necessitated increasing the plant 200 per cent, at which time the building took the form shown in photograph 1896.

to the manufacture of direct-current motors and generators, and was very successful in marketing this product. This direct-current line, however, was soon crowded out, owing to the large demands made upon factory capacity by the company's older line of manufacture.

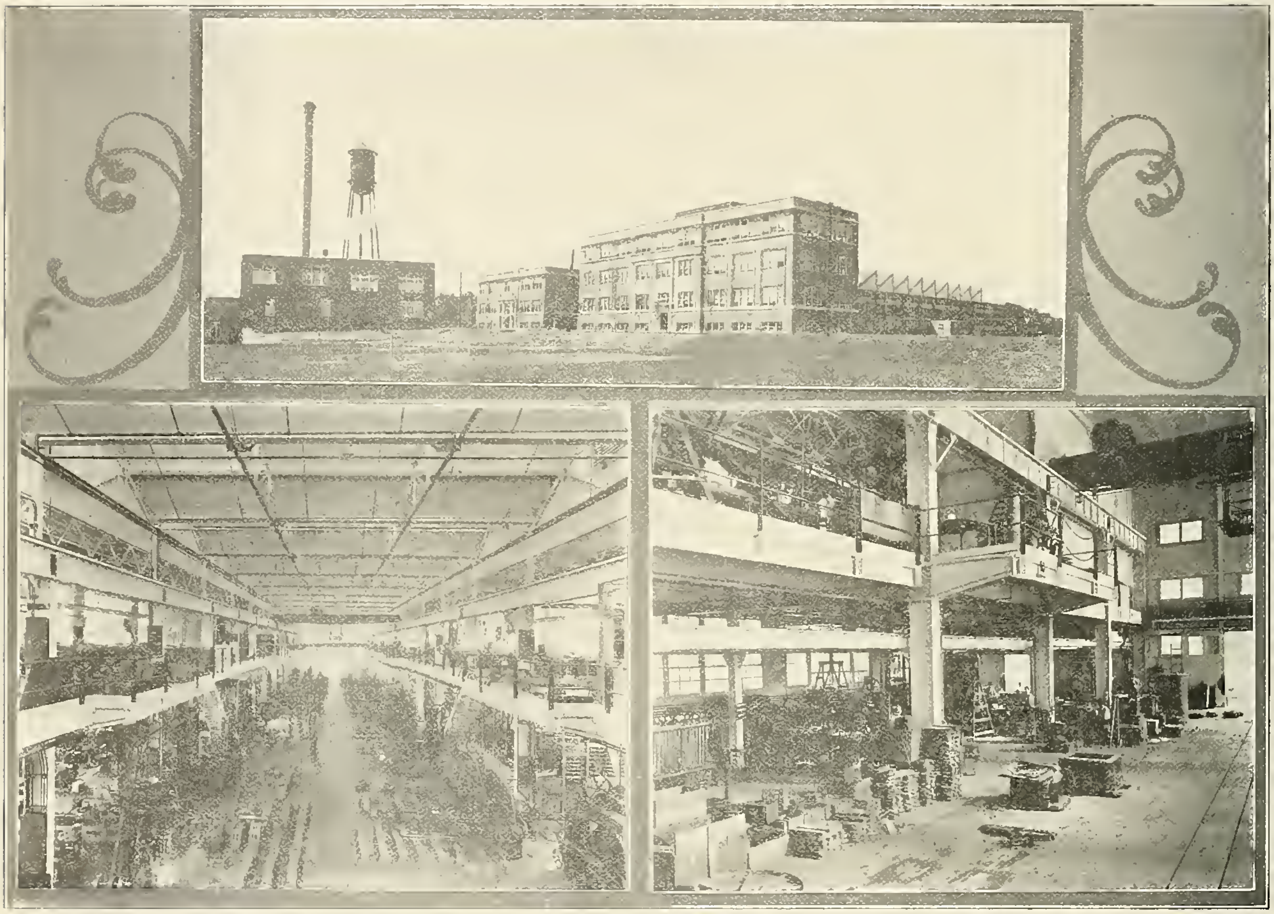
In 1896, several central station clients of the company enlisted its assistance in remodeling and improving their alternating current switchboard meters, these instruments having proven both unreliable in operation and very fragile. This practically forced the Wagner Company to design a line of such devices, and this line rapidly grew beyond the utmost expectations, and lent its part in compelling the company to provide an absolutely new plant for the proper handling of the business.

The old plant of the Wagner Company, together with the adjacent ground, which was used for storage purposes, was outgrown three years ago, when a careful search was made throughout the city of St. Louis and the surrounding country for a favorable factory site, which would be suitable for the erection of an entirely new and modern plant.

The company's new plant is located at Hillside Station, and is about 800 feet west of the city limits. The site comprises about fifteen acres, and is admirably located as regards sunlight and fresh air, and has unsurpassed shipping facilities.

The entire layout is arranged so that as the business expands, new factory units can be added and the work reclassed. A particular feature which is producing great results in the layout of this plant, is the system of sub-ways which connect the various buildings and departments.

The heating system is hot water under forced circulation, with temperature controlled by engineer at the power plant. The heating is graduated to the outside atmospheric conditions by manual regulation, by the engineer in charge. This heating installation is very complete, and is guaranteed by the manufacturers, the Evans-Almirall Co., to keep the buildings at 70 degrees.



POWER HOUSE AND ADMINISTRATION BLDG., WAGNER ELEC. MFG. CO.
MACHINE SHOP. TRANSFORMER ROOM.

An independent system of drinking water pipes is carried throughout the plant, and drinking water is supplied under a continuous circulation at a temperature of 60 degrees, this being maintained by a refrigerating machine driven by a Wagner single phase motor. The temperature regulation of this machine is entirely automatic. Drinking fountains are located at sufficiently frequent and convenient points throughout all buildings to bring a supply to within fifty feet of every employee, the water coming up in a mushroom-shaped cup, provided with a drain, so that a workman may obtain a drink from a stream of water under pressure, without fear of contamination, as no cups are used, the stream of water only being brought in contact with the lips.

The equipment for fire protection consists of a 75,000-gallon steel tank, 100 feet in the air, located immediately over a 150,000-gallon surface storage reservoir, this reservoir being located adjacent to the power plant. A fire pump, located in a pump-house adjacent to the reservoir, is kept under steam at all times, for service, should a fire break out. The system of sprinkling plugs located throughout the grounds is very complete, each one being a twin plug, around which is built a small fire house. Each house is equipped with axes, lanterns, hose and nozzle for quick action. A fire department has been organized and drilled for service should a fire break out at any time during factory hours. In addition to the fifteen twin plug stations, the entire factory is equipped with an interior system of water pipes with sprinkler heads. The outside water supply to fire pump consists of an eight-inch connection with service pipes of the St. Louis County Water Co., thereby insuring an adequate supply of water at high pressure at all times.

The view of the main machine shop shows the interior to be 100x312 feet, the galleries being 25 feet in the clear. The building has a sawtooth roof, the vertical panels facing the north. The building is served through its entire length by a ten-ton crane, operated by three-phase Wagner motors. The space underneath the galleries and the galleries proper are served by twenty-eight hand cranes, each one of which serves a limited area. This shop is equipped with the most up-to-date machinery known to the trade.

An interior view of a corner of the transformer shop shows the heavy steel construction, together with loading platform, so that the overhead crane may serve the gallery. The heavy and large transformers are built on the main floor of this building, the coil winding and insulation processes being conducted in the gallery.

As the apparatus of the company steadily underwent complete evolution, so also did the active personnel of the staff. From a business of small proportions calling for limited capital, and the personal attention only of its organizers, the corporation demanded and commanded the support of a strong coterie of St. Louis financiers on the financial side, and widening staff of engineering and executive heads on the administration side.

It is a notable fact that the Board of Directors of the company is to-day probably the most representative of any corporation in the city of St. Louis, comprising the active spirits of the city's foremost bankers, as shown in the following list:

Mr. S. M. Dodd, capitalist, President. Member of of the Board of the National Bank of Commerce, Commonwealth Trust Co., and Mercantile Trust Co.

Mr. James W. Bell, member of Board of National Bank of Commerce, and member of Board and Manager of Savings Department of Mercantile Trust Co.

Mr. J. C. Van Blarcom, President National Bank of Commerce.

Mr. Thos. H. West, President St. Louis Union Trust Co.

Mr. Jas. Campbell, capitalist. Controlling spirit of numerous large corporations, including railways, mining properties, and many others. President of the Telluride Power Trans. Co.

Mr. Albert Blair, Secretary and Counsel. Director and attorney for numerous industrial companies.

Mr. W. A. Layman, Vice-President and General Manager.

The engineering and administrative staff has undergone gradual evolution also. The directory heads have changed from time to time, active leaders in the business, seeking other fields, until today the active organization rests largely upon men who have been developed in the company's own plant, all of whom are well known in electrical fields.

M. S. DODD, President.
W. A. LAYMAN, V. P. and Gen. Mgr. W. S. THOMAS, Treas.
V. W. BERGENTHAL, Asst. Mgr. C. T LORD, Supt.
A. TIMMERMAN, Ch. Eng. W. ROBBINS, Asst. Gen. Mgr.

W. A. LAYMAN, VICE-PRES. AND GEN. MGR. Mr. Layman is a graduate of the Rose Polytechnic Institute, having been graduated in 1892, taking a degree of B. S. In 1894 he was given the degree of M. S. In 1896, E. E. Mr. Layman is a full member of the American Institute of Electrical Engineers, and past president of the Engineering Club of St. Louis. Mr. Layman began his work with the Wagner Elec. Mfg. Co. in September, 1892, as draftsman, serving successfully as the head of the Engineering Dept., Asst. Superintendent, Asst. Manager, and as General Manager of all departments since 1902. Mr. Layman was elected Vice-President of the organization in 1908.

W. ROBBINS, ASST. GEN. MGR. Mr. Robbins is a graduate of the University of Michigan, class of 1896, having taken the electrical engineering course. Immediately after his graduation, he entered the organization of the Western Elec. Co. of Chicago, having served in almost every capacity from salesman to Superintendent of Construction. Mr. Robbins also served two years on the manufacturing committee of the Western Electric Co., leaving that company in July, 1906, to associate himself with the Wagner Co., with headquarters in the main office at St. Louis.

W. S. THOMAS, TREASURER. Mr. Thomas is a graduate of the Illinois State University, having had fourteen years' experience as the manager and financial head of one of the largest wholesale coffee establishments in the West. Mr. Thomas' connection with the Wagner Company dates from December, 1907.

A. H. TIMMERMAN, CHIEF ENGINEER. Mr. Timmerman is a graduate of College City, of New York, B. S. in 1891, afterwards graduating from Cornell University; M. E. in E. E. in 1892, taking degree of M. M. E. in 1893. Mr. Timmerman was instructor of physics and electrical ebgineering in 1893-94 in the Washington University of St. Louis, and was Professor of physics and electrical engineering in the School of Mines and Metallurgy, University of Missouri, Rolla, Mo., from 1894 to 1899. In 1899 Mr. Timmerman entered the organization of the Wagner Company as Electrical Engineer, being made Asst. Superintendent in 1900, and Superintendent in 1902. Mr. Timmerman succeeded to the position of Chief Engineer in 1908.

C. B. LORD, SUPERINTENDENT. Mr. Lord was associated for seven years with the General Elec. Co. as General Foreman of the Train Control Dept. and Test Dept. After leaving the General Electric Co., Mr. Lord served as assistant superintendent with the Victor Talking Machine Co., of Camdem, N. J., associating himself with the Wagner Company, December, 1906.

V. W. BERGENTHAL, ASST. MGR. SALES. Mr. Bergenthal graduated from the Electrical Engineering Dept. of the University of Wisconsin with the degree of B. S. E. E., in 1897, and completed a post-graduate course in 1898, receiving the degree of E. E. Immediately thereafter he entered the ranks of the Stanley Elec. Mfg. Co., at Pittsfield, Mass., where he spent several years in the various engineering and testing departments, until he became the designing transformer engineer. After filling this position for a year, he was transferred to their Chicago office, assuming the duties of Western Sales Engineer, and later on was made Asst. Manager of that office. In the fall of 1903, Mr. Bergenthal left the Stanley Co., going to the American Automatic Switch & Signal Co., as its secretary, resigning that position in November, 1904, to join the staff of the Wagner Electric Mfg. Co.

NEWS NOTES

ILLUMINATION.

Banning, Cal.—B. B. de Crevecoeur began work on excavation for the gas plant this week.

Madera, Cal.—John F. Beales, of Los Angeles, has arrived here and is looking over the field with a view of installing a gas plant.

Riverside, Cal.—Plans and specifications have been filed for the plant of the Banning Home Gas Company. J. R. Thompson, of Los Angeles, is the contractor, the contract price being $14,500.

Pasadena, Cal.—As soon as additional supplies arrive and are assorted, Manager C. E. Koiner expects to put a force of men to work altering and completing the municipal street lighting system here.

Globe, Ariz.—The Globe Electric Light & Gas Company passed into the hands of Russell Palmer, of New York, on June 1st. It is proposed by the new company to spend $150,000 in improvements at the plant.

Santa Monica, Cal.—The City Clerk will receive sealed bids up to June 15th for furnishing and placing ornamental iron posts and installing necessary lights and wiring along the ocean front walk, between Pier and Hollister Avenue.

Azusa, Cal.—The Interstate Gas Company announces that the contract for laying gas mains through the streets of Azusa has been let to a Los Angeles contractor, and that the work of piping the city will begin in time to insure gas by August 1st.

Placerville, Cal.—At the last meeting of the Town Trustees, the report of Engineer White on the proposed municipal electric light and power plant was submitted. After considering it the Board adjourned without taking any action. The matter will again be taken up at a meeting to be held during the coming week.

Redlands, Cal.—C. S. Chestnut, president of the Redlands Gas & Electric Company, has been at Colton, conferring with Seth Hartley regarding the purchase of the Colton gas plant, the plan being to establish a plant at Colton to supply gas to Riverside, Redlands, San Bernardino, Colton, and later to Highland. This will do away with local plants in these cities.

San Francisco, Cal.—A bill naming 85 cents per 1000 feet as the legal charge to be made for supplying gas during the next fiscal year has been passed to print by the Board of Supervisors. John A. Britton, representing the gas company, made an argument in favor of the higher rate, going into details to show that from the company's standpoint, the revenue which the Supervisors proposed to allow would not yield a fair rate of interest to the stockholders of the company. He pointed out that the price of oil had materially increased, and that much new machinery had been or would have to be acquired. He said that for rate-fixing purposes the company had practically accepted the figures of the city's experts, and that the only differences between the estimates of the company and those of the city's experts as to the cost of producing gas, were the amount to be allowed for depreciation and the amount that constitutes a reasonable interest on such an investment as a gas plant. He stood strongly for the two and one-half per cent which had been asked for to cover depreciation, saying that not a gas plant existed to-day that had any of the plant which it had forty years ago, except, possibly, it might be in the case of a few miles of pipes. He also said that with the equipment which the gas company had in this city five years ago it would be impossible to produce gas to-day and sell it for less than $1.50 per 1000 feet.

TRANSPORTATION.

Redlands, Cal.—The Home Gas & Electric Company has signed a contract to furnish power for ten years to the Redlands & Yacaipa railway to be built this summer.

Albuquerque, N. M.—Plans are being prepared to install an electric car line on the highlands. Col. D. K. B. Sollers, who started the project some time ago, is behind the present movement.

Long Beach, Cal.—It is reported that the Pacific Electric Company intends to extend its line from Long Beach to San Pedro via a private right-of-way, the Long Beach Harbor and Commercial Street.

Los Angeles, Cal.—An ordinance has been passed granting the Pacific Electric Railway Company permission to lay temporary tracks over certain streets while the bridge is being built over Arroyo de los Poses.

Oakland, Cal.—The Supervisors of Alameda County have decided to grant A. W. Maltby and Joseph Napthaly permission to construct and operate an electric railroad through the tunnel connecting Alameda and Contra Costa Counties.

Salt Lake City, Utah.—Work will be started next Monday by the Utah Light & Railway Company on the new car barn and plant at Fifth South and Sixth East Streets. This will involve an expenditure of $600,000. Of this, it is expected that the car barns proper, costing in excess of $300,000, will be completed by the end of the year.

The first shipment of steel rails for the Redlands & Yacaipa Mile High Railway, has arrived. C. S. Chestnut, who secured some of the franchises for the Redlands & Yacaipa Electric Railway and lines in this city in connection with George H. Dunn, says that they intend to use at once the franchise granted C. C. Haskell and recently transferred to them.

Los Angeles, Cal.—The Los Angeles Inter-Urban Railway Company has contracted with W. N. Crandall for doing the grading for the La Habra Valley line in Los Angeles and Orange Counties, consideration sixteen cents per cubic yard for excavation, forty cents per cubic yard for hardpan, forty cents per cubic yard for loose rock, ninety cents per cubic yard for hard rock.

WATERWORKS.

San Diego, Cal.—A complete water system will be put in at Imperial Beach.

Los Angeles, Cal.—Surveyors are engaged mapping out a route for a pipe line from MacGruder mountain to Hornsilver, Nev., to convey water to the new camp.

Santa Cruz, Cal.—The City Council has taken preliminary steps for bonding the city for $100,000 for a new bridge, and the expansion of the electric light system and water supply.

Phoenix, Ariz.—Sealed proposals are being received by the Board of Trustees of Greenwood Cemetery for the construction of a system of water works for the Greenwood cemetery.

Los Angeles, Cal.—T. J. English has purchased a tract of land three and one-half miles southeast of Chino, and is driving a well, installing a pumping plant and putting in pipe lines to all parts of the tract.

Santa Cruz, Cal.—The San Vicente Lumber Company, which is getting ready for the erection of a saw mill at the edge of the city limits, petitioned for water and for fire protection, asking that the mains be extended to the plant.

Jamestown, Cal.—The Tuolumne Water & Power Company have completed the survey in Jamestown for the eleven-inch pipe line, which the company will have laid between the App ditch and Main Street. The fall from the ditch is 307 feet.

Los Angeles, Cal.—Following the driving of another big twelve-inch well at Beaumont, and sinking of a large shaft in water-bearing lands north of town, contracts are being awarded for nearly five miles of flumes and cement mines, comprising the fourth unit of the Beaumont irrigation system.

Los Angeles, Cal.—The Board of Water Commissioners is receiving sealed bids for fifteen tons of pig lead for caulking in cast iron water pipe, to be delivered at the warehouse of the Water Department, within thirty days after award of contract. The Board is also receiving bids for 100 six-inch gate valves.

Kingman, Ariz.—J. W. Wood, foreman of the Santa Fe water service, has a gang of men at work on two big water tanks which the company is to build at this place. As soon as tanks are completed they are to be connected up with a water system through the yards, mains being laid from the tanks up to Fifth Street.

Oakland, Cal.—Contracts have been awarded to the United Iron Works of Oakland to construct two auxiliary salt water pumping plants, the water to be used for street sprinkling; the plant on the northeast arm of Lake Merritt to cost $450, and the plant on the northwest arm will cost $475. The city agrees to construct the pits.

Ocean Park, Cal.—Preliminary steps have been taken by the Board of Trustees for the extension of the salt water mains from Venice to other portions of Ocean Park, which at present do not have fire protection. The city has 4,000 feet of eight-inch pipe on hand, and this will be laid at once to extend the salt water mains to the northern part of the resort.

TRANSMISSION.

Eureka, Cal.—G. M. Scott claims 500 inches of water in "Old Mill Creek" for generating electric power and for other purposes.

Redding, Cal.—David E. Aldridge has appropriated 3,000 inches of water flowing in the bed of North Bear Creek for generating electricity for power, lighting and other purposes.

Sacramento, Cal.—The Great Western Power Company has filed an acceptance of the ordinance granting the company the right to plant its poles and towers and stretch its cables and wires in this county.

Pasadena, Cal.—The City Clerk is receiving bids for furnishing the city the following items: poles, triple braid, medium hard drawn, weather proof copper wire; cross arms, galvanized cross-arms, brass and carriage bolts.

Manhattan, Nev.—F. L. Sigel, of Denver, president of the California-Nevada Power Company, was here a few days ago and stated that the company's line will probably be extended into Manhattan and Round Mountain by fall.

Modesto, Cal.—A complaint filed in the Superior Court for condemnation of right-of-way shows that the Tuolumne Water Power Company, which filed articles of incorporation in this county on April 14th, has already begun work on the construction of its power line across Stanislaus County. The company is generating its power on the Upper Stanislaus, and will construct a power line on an air line through Calaveras, Stanislaus, San Joaquin, Alameda, and Santa Clara Counties to a point south of the Bay, and from there into San Francisco.

Bakersfield, Cal.—The Edison Electric Company's plant in the Kern River Canyon is now supplying all the power which the company uses in the southern part of the State, the other plants in the South being shut down. The reason given is one of economy. Sufficient power can be generated by the local plant so long as the present flow of water continues, and it is generated at the minimum cost. During the week the battleship fleet was in Los Angeles, the exceptional amount of work required of the cars and other users of electricity made it necessary to start up one of the other plants, and one or more of these Southern plants will be used this summer when the water in Kern River is low. There is much less water in the river now than last year at this time, and a considerable decrease is expected later on. So far, the power plant has not used anywhere near all the water available, and it is now generating 40,000 horse-power. To handle and care for the plant and do the necessary work of maintenance, twelve men are employed, or only one man to every 3,000 horse-power.

INCORPORATIONS.

San Francisco, Cal.—The Black Canyon Oil Company has been incorporated with a capital stock of $1,000,000 by W. H. Pabst, C. Withers, C. A. Davis, J. B. Batz, A. F. Rodgers, C. A. Slack and J. H. Jordan.

Bakersfield, Cal.—The Babcock Petroleum Company has been incorporated with a capital stock of $1,000,000 by F. W. Babcock, of Providence, R. I.; E. E. Powers, W. H. S. Welch, L. R. Powers and F. N. Notman, all of Los Angeles.

Pt. Richmond, Cal.—The Bay Shore Electric Light & Power Company has been incorporated with a capital stock of $500,000 by W. H. George, of San Francisco; M. R. Jones, of Martinez; A. E. Steinberg, of Port Costa; E. M. Downer and L. E. Hart, of Pinole.

OIL.

Sacramento, Cal.—Bids will be received at the office of M. J. Desmond, City Clerk, until June 8th, for furnishing the city water works, the city sewering pumping station, at Front and S Streets, city sewer pumping station at Front and U Streets, and the city garbage crematory in block bounded by V, W, Front and Second Streets, with fuel oil for a term of one year from date of approval of contract.

Stockton, Cal.—The Stockton capitalists who are interested in the oil fields of the Sunset district near Bakersfield, and who have incorporated under the firm name of the Gate City Oil Company, have received news that another rich well has been struck. The new well is now down 735 feet, and oil flows from the depths at the rate of 200 barrels per day. The quality being received is known as thirteen per cent gravity. The Stockton Company has secured a lease of twenty acres for fifteen years, and expects to bore eight wells on the territory. The officers of the local corporation are: J. W. Mosier, president; Ira E. Smith, secretary and manager; J. Jerome Smith, treasurer.

Los Angeles, Cal.—A gusher producing a twenty-four gravity petroleum was brought in some ten days ago sixty or sixty-five miles south of Ebano, Mexico, on land belonging to one of the subsidiary companies of the Huasteca Oil Company of this city, controlled by the Mexican Petroleum, Ltd. The output is variously estimated at from 800 to 2,000 barrels a day. It is the lightest yet found in that region, but is similar to what Pearsons have on the Tehuantepec Isthmus. The strike was at 2,000 feet. The scene of the strike is within seven miles of water transportation on the Laguna de Tamiahua, an inlet of the Mexican Gulf, on which, and on the river to Ebano, the company operates two steamers. It has also a yacht for river service, which has been in use eight years, but which could not enter the Laguna on account of its shallowness. Three other wells are to start as soon as the material can be brought in.

San Francisco, Cal.—The Amalgamated Oil Company, controlled by the Associated Oil Company, has just completed boring a new well which will prove a great asset. This well is now producing from 5,000 to 10,000 barrels of oil a day, but aside from its individual value, the discovery means much to the company as indicative of the richness of an entirely new field. The new well is located only a half mile west of Los Angeles, and opens a territory of some 640 acres, all of which can now be considered available as highly productive oil bearing land. The Amalgamated Oil Company is one of the Southern California companies of the Associated and controls a tract of remarkable value some eight miles long, and varying from one to three miles in width. In this field there are about twelve square miles, all situated between Los Angeles and the ocean. On June 1st the Associated Oil Company will move its offices from the eleventh floor of the Kohl Building, at Montgomery and California Streets, to the seventh floor of the new Wells Fargo Building, at Second and Mission Streets, where even more elegant offices than those it now occupies are being prepared.

TELEPHONE AND TELEGRAPH.

San Francisco.—The Board of Supervisors has passed the ordinance reducing the charge for telephones, recently introduced by Mr. Murphy.

San Francisco.—Bids on the propositions for constructing buildings and doing other preliminary work in connection with the installation of wireless telegraph stations at Fort Egbert, Nome, and Fort Gibbon have been opened. A steel tower 200 feet high is to be furnished by the Government, but the material for stations, which will be built according to specifications prepared in Washington, modified and adapted to the conditions existing in Alaska, will be furnished by contractors.

THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., JUNE 13, 1908 No. 24

INDEPENDENT HIGH PRESSURE FIRE SYSTEMS.*

In the United States, during the last fifteen years, high pressure fire lines have been a most important development. Among the earliest of these were the so-called "empty mains" leading from the rivers back into the business sections of Cleveland, Detroit, Milwaukee, and other lake cities. At Cleveland, for instance, some 16,500 feet of 6-inch, 8-inch and 10-inch cast iron pipe have been put down since early in 1891, affording additional protection partly in the business section and partly in the lumber district. When a large fire occurs in the protected area, the harbor fire boats, one of 7,000 and the other of 4,000 gallons capacity per minute, connect with these mains and effectively assist the city fire department. While kept full in summer, as these mains were not laid below frost line they are drained in winter; but the fire boats fill them quickly and provide a pressure of about 100 to 150 pounds at the hydrants in business streets well above the river. These mains at Cleveland have proven so effective that plans are now under consideration for large extensions, including perhaps an independent pumping station. At Detroit there are about 26,000 feet of 8-inch and 10-inch pipe, chiefly in separate 8-inch lines of various lengths, in business streets running back from the river, and served by fire boats. Two of these 8-inch lines are connected through 10-inch line laid in the business center. At Milwaukee, there are about 46,000 feet of similar 8-inch and 10-inch pipe in streets running back from the rivers and canals. At Buffalo, since the fall of 1897, about 8,800 feet of independent mains have been installed. The first of these mains were of steel, and the latter of cast iron, this change being necessary on account of the deterioration of the steel pipe. They are kept full in summer, and empty during extreme cold weather. One or two fire boats are used, as necessity requires, and at the farthest hydrant a pressure of 275 pounds has been obtained and maintained, and on one test the two boats gave a pressure of 350 pounds at a distance of 2,500 feet with one line from the hydrant. In practice, the pressure, of course, varies with the number of lines in use at a fire, and we understand that it rarely exceeds 200 pounds at the hydrant. One objection to these independent fire boat mains is that the fire boats may be prevented, by shipping, the blocking of slips by vessels, and in winter because of ice, from promptly reaching the bulkhead line for connection to mains. It is claimed that the fact that the pipes are empty in winter does not delay the supply, as the time occupied by fire boats in filling the mains about equals the time used by the fire company in proceeding from quarters and connecting hose to hydrant. On the other hand,

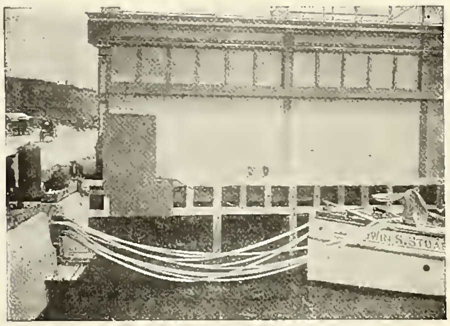
HIGH PRESSURE FIRE STREAM.

SIX HIGH PRESSURE STREAMS FROM ONE HYDRANT.

*Contributed by R. W. Martindale.

some engineers claim that these fire mains should be laid below frost line and kept full, always ready, and where practicable, connected up to sprinkler systems and to a standpipe in all large buildings, the high pressure to be turned in from street when necessary. These connections should prove a source of revenue, or at least cover their cost and maintenance. Probably the first complete system of independent fire mains is that at Providence, R. I., which was put down in 1897, and consists of some 29,400 feet of 12-inch, 16-inch and 24-inch cast iron pipe, supplied by gravity, which affords about 100 pounds pressure at the hydrants. The system is so designed, however, as to admit of adding pumps to bring the pressure up to about 150 pounds at the hydrant.

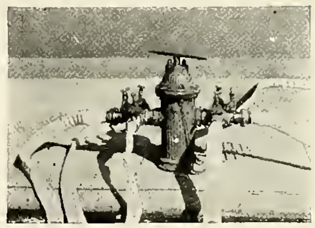
Later developments in the separate fire main systems are those at Philadelphia and Brooklyn, the latter as yet hardly complete. They are independent high pressure plants, ready for instant use. The mains laid below frost line are kept full under moderate pressure the year around, provision being made for circulation and draining, and they are connected with independent stations in which are installed high pressure power pumps, which on signal bring the pressure almost immediately up to 200 pounds or more at the hydrant.



FIRE BOAT CONNECTION.

In Philadelphia the present system, which comprises some 34,000 feet of pipe, is an added protection to the congested area, which is about 6,500 feet long, running back from the Delaware River to Broad Street, by about 2,500 feet wide, between Walnut and Race Streets. The water supply is taken from the river. The pump house is on the water front, and is connected with numerous telephone stations throughout the district, and with the regular fire alarm system. There are also several fire boat connections for emergencies. The pump house contains seven units, with a combined capacity of about 10,400 gallons per minute. These are triplex, double-acting, geared plunger pumps, driven by gas engines. They supply a 20-inch discharge main, which, a short distance from the station, branches into 16-inch mains. There are three 12-inch mains and one 16-inch main leading from the river front to Broad Street, with cross connections of 8-inch mains at intervals of about every three blocks. These diameters are nominal, being reduced more or less by the thickness of metal in the pipe used. The mains, normally under about 75 pounds pressure, are kept filled through check valve connections with certain of the city water mains. In case of fire, within a minute the pressure at any hydrant may be brought up to 200 pounds or more if necessary. The pipe are all of cast iron, but in this Philadelphia system, flange pipe were used, and after completion, lead expansion joints were inserted to overcome the difficulty experienced with the flanged joints owing to expansion and contraction. For the earlier installations, including the fire line at Boston, the new systems at Brooklyn, and for the Manhattan district, New York, cast iron bell and spigot pipe were adopted. At Philadelphia, the hydrants are of the gate type, the pressure tending to force the valve off the seat, while those at Brooklyn are of the compression type, the tendency of the water pressure being to close the valve. While the New York and Brooklyn systems are naturally expected to be a marked improvement upon the earlier Philadelphia system, the latter has so far given excellent service, and in the congested section covered, the Board of Fire Underwriters have reduced the insurance rates 25 cents per $100, which represents a large annual saving in the cost of insurance in the protected district. In Brooklyn, it is estimated a similar reduction in the cost of insurance would result in a "saving of about $550,000 a year, which represents about 7.7 times the total estimated cost of maintenance and operation, plus interest and sinking fund charges for the high pressure fire system." The credit in Philadelphia, however, was in part due to the removal of a penalty for deficient water supply.

In the general scheme of the new installation of high pressure fire mains in New York, two independent pumping stations on the water front are provided, each having a present capacity of 15,000 gallons per minute, the pumps to be of the centrifugal type, multi-stage, direct connected to electric motors, which, in starting, will insure service at full pressure in about one minute. The pumps are designed to readily give 300 pounds pressure at the pump house, which, allowing for frictional loss in the mains, will give a pressure at the base of all hydrants of about 250 pounds per square inch. In each station the intake and discharge lines to the distribution mains will be duplicated, and at each station the pumping plant will be divided into so many units that it will be practically impossible for any station to completely break down or entirely cripple the high pressure system. The distribution mains will be of the cast iron bell and spigot type, having deep double lead grooves in both bell and spigot ends of the pipe. The special castings are of cast iron, with the exception of the larger tees and crosses, which, weakened by the area cut out for the branches, will be made of steel. The pipe will be of 1⅞-inch metal for 24-inch size, 1½-inch metal for 20-inch size, 1¼-inch metal for 16-inch size, 1-inch metal for 12-inch size, and ⅞-inch metal for 8-inch size (the latter for hydrant connections only), and tested at the foundry to a pressure of 650 pounds per square inch. These pipe are similar to those used in the Brooklyn system, in which 20-inch is now the largest diameter, and it will be noted that these cast iron pipe to work under 250 pounds pressure at the hydrant, are of the bell and spigot type, calked with lead in the ordinary way. Such joints have been tested to 750 pounds pressure, while 250 pounds is usually considered ample for these high pressure fire mains. The use of such mains is steadily finding favor, and must increase as their value and the lessened cost of insurance becomes apparent.



SIX LINES FROM HIGH PRESSURE HYDRANT.

Probably the most notable and comprehensive system of fire protection is that contemplated by the city of San Francisco. After an exhaustive study of all the high pressure fire service systems in the United States and Canada installed, and proposed, embracing twenty-two cities, and the peculiar and interesting conditions in San Francisco, the plans were prepared and the system outlined fully in a printed report by Marsden Manson, C. E., City Engineer, also H. D. H. Cormick, Chief Assistant Engineer Board of Public Works, and T. W. Ransom, Consulting Mechanical Engineer, and under the direction of the Board of Public Works.

It is proposed to lay more than 91 miles of cast iron bell and spigot pipe with lead joints of sizes from 12 inch to 20 inch. All hydrant connections will be 8 inches. Cast iron has been adopted as the most serviceable metal, as at times the mains will be filled with salt water. It is a well known fact that cast iron deteriorates by corrosion more slowly than steel. Cast iron pipe, owing to its much lower tensile strength, must be made from 200 per cent to 300 per cent thicker than steel pipe to stand the pressures under which the system is to be operated. This greater volume of metal of itself insures a long life for the pipe.

The bell and spigot joint made with lead is flexible to a considerable degree, and will to a certain extent take care of vibrations due to earthquakes and strains on the pipe lines due to subsidence. In portions of the city which are over-made or filled ground a special lead joint made by butting two spigot ends of pipe together in a long special cast iron sleeve, will be used, as it has been shown that the greatest damage to the present domestic supply system occurred in such sections. Valves will be so located that in case any part of the pipe system is broken, such sections can be cut out without impairing the efficiency of the rest of the system. The acreage covered by the proposed system will be about 5,300 or double the area burned over in the great conflagration of April, 1906, and greater by more than 300 per cent than is covered by the present system in New York City.

The amount of water to be supplied through the mains will be 35,000 gallons per minute, or about 16 per cent more than is contemplated by the systems of Chicago and New York.

The mains will be kept filled with fresh water by gravity from reservoirs filled by pumps, and pressures for fire purposes up to 327 pounds per square inch will be available.

Two storage reservoirs of 5,000,000 gallons capacity will be constructed on Twin Peaks at an elevation of 755 feet. A distributing reservoir of 500,000 gallons capacity will be located in the city overlooking a portion of the residential district at 495 feet elevation, and above the business district at an elevation of 329 feet will be constructed a low level distributing reservoir of 1,000,000 gallons capacity. The pumps supplying these reservoirs will have a capacity of 3,000,000 gallons daily. Two salt water emergency pumping stations will be located on the bay on opposite sides of the city with an ultimate capacity of 16,000 gallons per minute. Two fire boats are proposed, having a combined capacity of 8,000 gallons per minute, under 300 pounds pressure, and 4,000 gallons per minute under 150 pounds pressure.

A number of underground cisterns will be constructed in the streets. A telephone system for the exclusive use of the Fire Department is proposed.

The complete system is estimated to cost $5,200,000.

The situation of San Francisco is almost ideal for the installation of such a system of fire protection as outlined. The numerous hills of good elevation in and around the city provide locations for reservoirs, and insure by gravity all the pressure necessary to extinguish ordinary fires. In an emergency when great quantities of water are required, as in the case of a general conflagration, the salt water pumping stations will be brought into service as well as the fire boats on the bay.

A great system such as proposed is more necessary in San Francisco than in almost any other city in the country, owing to climatic and topographic conditions and the combustible nature of a large percentage of the buildings.

It is thought that the construction of the system as planned will be the means of a considerable reduction in insurance rates which are now unusually high.

Mention should be made that many of the smaller cities in the country are considering the installation of separate systems for fire protection. The city of Ocean Park, California, has on hand 4,400 feet of heavy cast iron bell and spigot pipe, which will shortly be laid between that city and Venice, to better protect them from fire. The city of Hanford has now under construction the second section of a separate system for fire protection, and here again cast iron bell and spigot pipe will be used of 6-inch and 8-inch size. The pressure here will be 140 pounds per square inch. When the first section was planned at Hanford sufficient consideration of the pipe to be used was not given, and cast iron pipe made in green sand of short lengths, and with rigid bolted joints were laid. The experience of Hanford and many other small cities goes to show the necessity at all times of securing the services of a competent engineer to lay out the work. The necessary expense for a good engineer and the best materials in so important an undertaking will be amply repaid by the added value of the system and the surety that it can be relied upon in an emergency. Then, too, a well laid out and constructed system is often the means of a substantial reduction in insurance rates, especially if it meet the requirements of the Board of Fire Underwriters. The city of Lodi recently voted bonds for the construction of a water works system of cast iron bell and spigot pipe, for fire protection and domestic supply. No expense will be spared to make the system effective. It was planned by an engineer of wide experience, along the lines of rules laid down by the Board of Fire Underwriters, and it is probable a reduction will be granted in fire insurance rates.

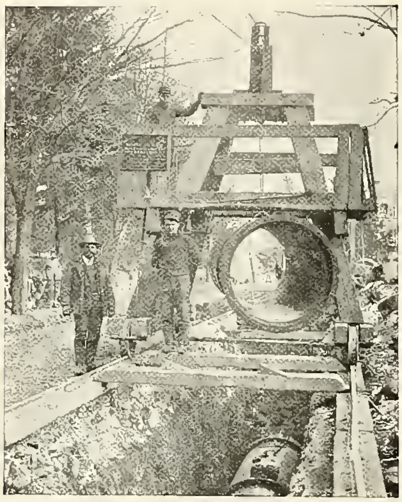
Chicago, Baltimore, Toronto and other cities have under consideration important independent fire main installations. Not only for large cities and towns are these mains practicable, but for important isolated manufacturing plants will they find favor. Many of the latter have their own electric power, which in case of fire could readily be diverted to electric motors direct connected to the centrifugal or other power pumps of an independent fire system, which in some instances can be combined with village or town protection. The effect on insurance rates will often justify the protected property owners in assuming alone the cost of installation and maintenance.

Hydraulic Power Mains.

For pressures up to 750 pounds, the smaller sizes of cast iron bell and spigot pipe may be used around manufacturing plants for underground mains, the form of socket being altered somewhat for pressures above 250 pounds. Such piping is made to order only. While hydraulic power is largely used by steel works and other manufacturing plants in this country, we have no installation for public supply corresponding to the well known plant of the London Hydraulic Power Company, which has now been in successful operation for more than twenty years, and supplies motive power from over 150 miles of mains, to which in 1905 were connected 5,597 machines. The power is available day and night the year around, operating direct-acting hydraulic lifts and motors, and is also used for injector fire hydrants, affording special fire protection, and for ejectors, the latter being extensively used for raising water. The first of these independent hydraulic power works was put down in 1877 at Hull. The plant in London was commenced seven years later, and such works have now been installed in Liverpool, Manchester, Glasgow and other cities in England, and at Melbourne and Sydney in Australia. In London, the company pumps its

water from the Thames, while in Manchester, for instance, the supply is taken from the city mains, which saves much in pumping. In London, the working pressure is 700 pounds, while in Manchester it is 1,120 pounds. All of the mains are of cast iron. Hydraulic power has uses and advantages which even electricity cannot supplant, and it would seem that in congested districts similar power plants could be worked to advantage and economy for office building elevators and lifts, and presses in warehouses, releasing valuable space now occupied by pumps and extra boilers, to say nothing of its use for numerous other power purposes.

In London, the average charge for hydraulic power is much the same as the average charge for electric energy within the same area, and as compared with electric lifts, the hydraulic elevator is certainly as good if not better, whether considered from the view point of safety, economy or convenience.



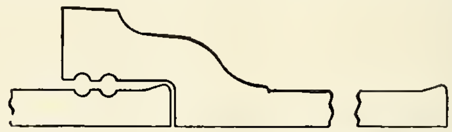
HANDLING PIPE WITH MOORE'S PATENT TRAVELER.

Sewers.

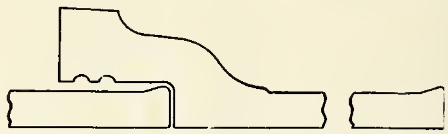
There is a notable and very marked increase in the use of cast iron pipe for sewers, not only for sewage force mains, but especially in locations liable to subsidence, such as in marshy ground, newly filled streets, or where the sub-soil conditions make desirable a more permanent construction than is secured by the ordinary brick sewer. Cast iron pipe are also used to advantage on hills, where the rush of water during storms is liable to wash out the ordinary brick or tile sewer which may have been disturbed by the action of frost. During the past year the leading cast iron pipe manufacturers have furnished for sewers, several lines of 30-inch to 60-inch cast iron pipe, and their increasing use for sewers has become an important factor. Except for force mains, usually standard pipe of dimensions and weights suitable for pressures due to not over 100 feet head are specified, but there are often locations which necessitate the use of heavier pipe. The thickness of pipe to be used is a question for the engineer, and while the use of cast iron pipe naturally involves a larger initial cost than for other culvert materials, this difference is inconsiderable when compared with advantages secured through the more substantial and lasting construction.

Culverts and Drains.

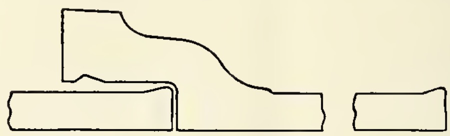
The very extensive use nowadays of cast iron pipe for railroad culverts and drains is well understood, as is also their adoption by township commissioners for drains under country roads. They are indeed an important factor in "good roads" development. The largely increased demand is the natural result which has followed the appreciation of the many advantages derived from the use of cast iron pipe for culverts. One length of cast iron pipe will lay 12 feet, and may be used instead of six 2-foot lengths of vitrified pipe, thus minimizing the risk of washout by markedly reducing the number of joints. As compared with a brick or stone culvert, the cast iron pipe culvert is less liable to be affected by the action of frost, while the smooth interior of the pipe is not easily obstructed and may readily be cleaned. Aside from this, cast iron pipe culverts are of relatively great strength and easily and cheaply put down, it being simply necessary to see that the pipe have an even bearing, that the joints are supported, and that the material about the pipe is carefully tamped under and around them, at least up to their center line. They are



DOUBLE GROOVE BELL AND SPIGOT HIGH PRESSURE PIPE.



DOUBLE GROOVE BELL AND REGULAR SPIGOT HIGH PRESSURE PIPE.



STANDARD HIGH PRESSURE BELL AND SPIGOT.

often laid even without the setting in masonry of the upstream end. A brick or masonry facing, however, is desirable for permanent culverts, as tending to prevent undermining the pipe. Where roads cross streams which in times of freshet may be greatly enlarged, it is not unusual to provide several parallel lines of pipe to take care of the increased flow. Cast iron pipe is now made up to 84 inches inside diameter. Where there is not space for the larger diameters, two or more parallel lines of smaller pipe may often be used to advantage. The following table shows the weight per cubic foot of embankment material. To determine the pressure per square foot of embankment upon the horizontal surface of pipe, multiply the weight per cubic foot by the height of the fill above the pipe. Thus, it will be seen, for high embankments only heavy pipe should be used, and great care taken to so lay the pipe that they will not be subject to undue subsidence:

Embankment Materials—Weights per Cubic Foot.

Material	Average Weight	Specific Gravity	Average Voids
Granite	166 pounds	2.666	.....
Coarse Gravel	120 pounds	1.925	.28%
Gravel	116 pounds	1.861	.30%
Sharp Sand	110 pounds	1.765	.33%
Clay	125 pounds	1.440	.12%
Water	62.5 pounds	1.000	.....

DIRECT AIR PRESSURE PUMPING.

As a preliminary to the description of the oil engine plant just installed in the pumping station at Cypress Lawn Cemetery, near San Francisco, the following details of a similar system will prove of interest. At Cypress Lawn the engine drives an air compressor, furnishing air for pumping, and also drives a triplex pump, forcing water from the reservoir through the mains:

During several months of the year 1907, an extended series of tests was made on a driven well, near the plant of the Westinghouse Air Brake Company, at Wilmerding, Pa., to determine the amount of water raised, air required, and other necessary data relative to pumping by direct air pressure. As wide a range of conditions as possible was covered in regard to different sizes of pipe and different combinations of "lift" and "submergence," obtaining for each condition the most suitable and economical arrangement. The "lift" is the vertical distance from the water level in the well to the point at which the water is discharged. The "submergence" is the distance from the water level down to the point in the well where air is admitted to the discharge pipe.

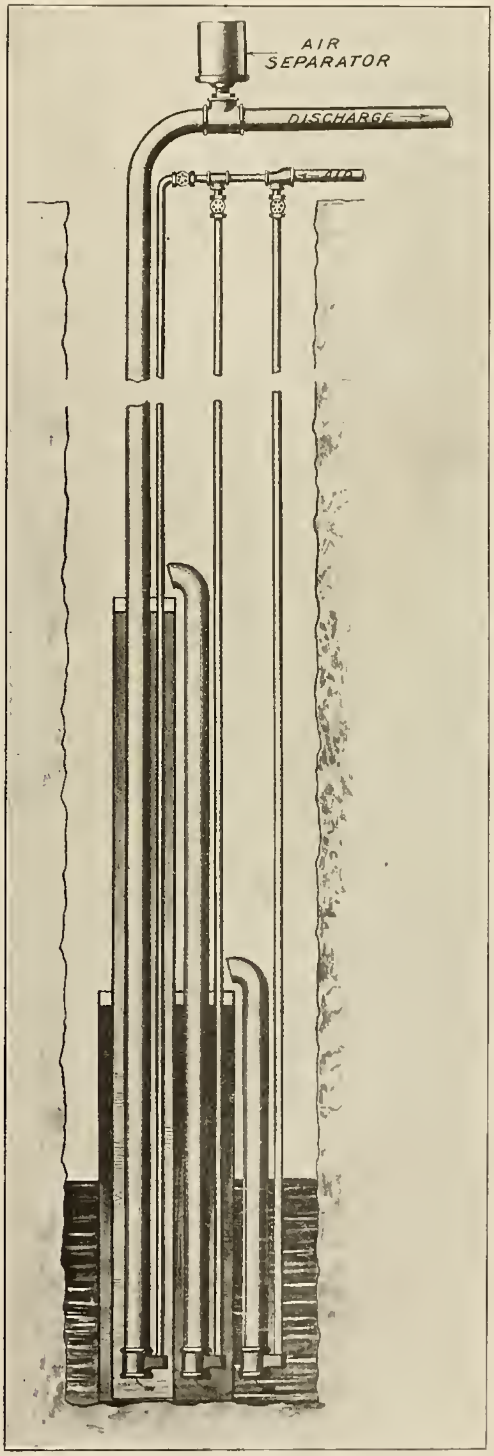
Since the variety of combinations of these distances and sizes is infinite, a limited number of each were determined upon, which would give enough points on a curve to cover practically the entire range for each size of pipe.

Arrangement of Apparatus.

The well used is 174 feet deep from the surface of the ground, has 6-inch casing, and the water level is ordinarily from 16 feet to 20 feet below the surface. An oil well derrick was constructed over the well, with platforms at various heights to provide means for altering the lift. The space inside the derrick, below the first platform, was housed in to protect those making the tests, and provide suitable space for the tanks, measuring apparatus, etc., required. Each length of pipe was measured and marked as it was placed in the discharge pipe, so that an accurate knowledge of the distance to the air inlet and to point of discharge was always at hand. To measure the distance from the ground to the water level, a float was used, consisting of a tin tube about ½ inch in diameter and 4½ feet long, hermetically sealed, weighted at the bottom, so as to float vertically, and pointed at both ends to assist in its introduction into, or removal from the casing. A stout "Silver Lake" cord was fastened to a ring in the upper end, and brass markers were attached to this cord every four feet, each marker stamped with the distance from the water level point on the float.

The air supply was obtained from a one-inch connection to the air system of the Westinghouse air brake shops. The arrangement of piping, reservoirs, etc., is shown diagrammatically in Fig. 1. Two air storage reservoirs, 30½x84 inches, received air from the supply through a three-way cock, so that only one tank could be charged at one time. At the other end of these tanks, connection was made through a similar three-way cock to the line to the well. In this line was placed a 14x33-inch reservoir, a globe valve and a cutout cock. The shop air system averages from 140 to 160 pounds pressure, to which the storage tanks were charged. Tank No. 2 was used for measuring the air in the tests, and Tank No. 1 for starting the pumping operation. The volumes of these tanks and their piping was obtained by water measurements. A special test gauge was attached to tank No. 2. The globe valve in the well line was used to regulate the pressure in the latter. Such pressure was always much less than the storage pressure, and had to be held constant. The cutout cock was used for cutting off all supply to the well. The small reservoir simply increased the volume of the well line to make it easier to hold its pressure constant.

The special fitting used for admitting air into the discharge pipe is also shown in Fig. 1; it consisted of a pipe sleeve enlarged on one side, the upper surface of the enlarged part being drilled and tapped for three air pipes and 1¼-inch gauge pipe. With the large discharge pipes, there was not room enough inside the casing to get a large air supply pipe; so that two or three smaller sizes were substituted. By this arrangement, also, the effect of changing the sizes of air



COMPOUND ARRANGEMENT OF DIRECT AIR PRESSURE PUMPS, FOR SHALLOW WELLS.

supply pipes was easily obtained, since any one of these pipes could be closed at the top by suitable cutout cocks. The gauge pipe was connected with a test gauge to show the pressure of the air entering the well. The water is always blown

out of this pipe when starting the pumping operation. Another test gauge was placed in the air line to the well, so that pressures at top and bottom of air inlet pipe were noted.

The discharge pipe passed up through the roof of the cabin to the point of discharge, at this point the air and water lifted passed into an air separator, shown in Fig. 2. The air passing upward to the atmosphere, and the water falling by gravity into one of the two weighing tanks. Just under the roof of the cabin was a large three-way cock, by means of which the water was directed into either one of the tanks and weighed by means of the platform scales upon which they rested.

The Tests.

Nearly eighteen hundred tests were made, covering from 350 to 400 different combinations of discharge pipe lift and submergence. From the figures obtained in these tests, curves were plotted, showing the variation of cubic feet of air used per gallon of water raised, and the gallons of water delivered per minute, for the different ratios of lift to submergence.

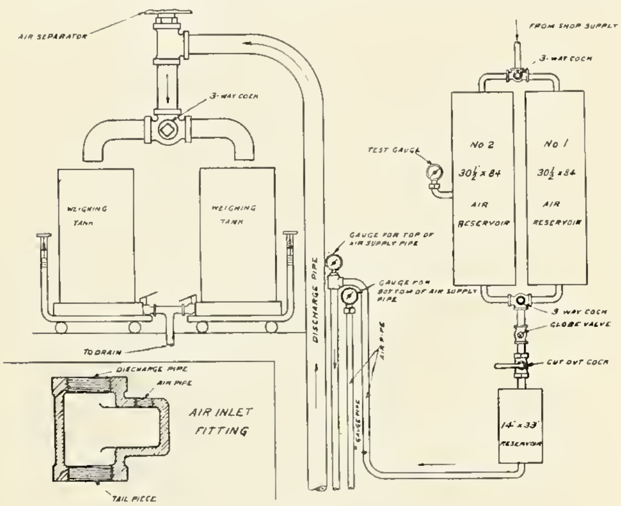


FIG. 1. PIPING DIAGRAM.

From these curves, it was found that the cubic feet of air used per gallon of water raised, and the gallons of water delivered per minute, are practically the same for each ratio of lift to submergence for any submergence of a given size of discharge pipe. For example, a lift of 10 feet and a submergence of 20 feet will take the same amount of air per gallon, or lift the same number of gallons per minute, as a lift of 100 feet and a submergence of 200 feet, the size of discharge pipe being the same. In both these cases the ratio is identical, while the submergence in the latter is ten times as great as that in the former. Consequently, it is only necessary to consider the ratio of lift to submergence and the size of discharge pipe.

It was also found that, for a given size of discharge pipe, the gallons of water raised per minute decrease as the ratio of lift to submergence increases. Also, the cubic feet of free air per gallon of water raised increase as the ratio increases for a given size of discharge pipe, and for a given ratio, it decreases as the size of discharge pipe increases.

Air Pressure.

As regards the air pressure required, it was found that the smallest pressure possible that would give a continuous flow from the well, was the proper pressure to use. It was found that, if the air pressure was choked down slightly below this point, the water would come out intermittently in spurts, and the air required per gallon was slightly less than with the continuous flow, but the water delivered was considerably less. On the other hand, if the air pressure was gradually increased above that just required to give a steady flow, the quantity of water delivered would increase somewhat, but the air per gallon increases in a greater proportion, and, as the air pressure is further increased, the gain in the quantity of water delivered grows less until, at a certain point, it stops, and from then on the water delivered decreases in amount.

It is very easy to regulate the air supply by the sound of the discharge. The point at which the flow becomes steady is quickly recognized.

Selection of Proper Ratios.

From the results obtained, it would appear that for a given lift, the further down in the well the submergence is made, the more economical the result would be. This is true so far as the well is concerned, but it must be considered that the greater the depth of the air inlet, the greater the air pressure must be, and, consequently, the more horsepower must be employed to compress the air. The quantity of air required to operate the well decreases as the depth is greater, while the horsepower required to compress a cubic foot of air increases with the depth. A curve representing the horsepower per gallon of water raised for varying depths and constant lift, will at first decrease as the depth increases, until it reaches a minimum point, after which it increases. This point represents the most economical ratio for the given lift. To learn where this point would be, some tables and curves were made, which gave the horsepower per gallon of water raised for the different lifts and different sizes of pipe, with various ratios of lift and submergence, from which it appears that the most economical ratios for a given discharge pipe decrease as the lift increases, and for a given lift they increase as the discharge pipe increases.

Concerning the use of a "tail" piece in the discharge pipe below the air inlet, it was found that this piece is essential when starting the pumping operation, as it tends to prevent the air from backing down into the well and rising in the casing, outside of the discharge pipe.

The fitting used for entering the air into the discharge pipe was particularly well adapted to the purpose, because it offered no impediment to the free passage of the water. The results obtained indicate beyond doubt that anything in the shape of a jet or pipe, introduced into the discharge pipe, not only has no value in assisting the pumping operation but is actually detrimental, by forming an obstacle to the free passage of water. The enlarged sleeve not only offers little resistance to the water, but makes it possible to install the air pipe very close to the discharge pipe.

Size of Air Pipe.

The size of air pipe depends upon the quantity of air required, its pressure and velocity, the latter depends upon the difference in pressure between the top and bottom of the air supply pipe, or, in other words, how many pounds pressure one is willing to sacrifice to force the air through the pipe.

Taking the results of the tests, and assuming that the drop in pressure is proportional to the length of the air supply pipe, it was found that, for one pound drop per hundred feet, the velocity is about 27 ft. per second; for 2 pounds drop 42 ft. per second, and for 3 pounds drop 53 ft. per second. Economical operation is, of course, more easily maintained by having the drop in air pressure as small as possible.

Perhaps it would be well to give here a brief description of the manner in which the operation occurs inside the well. As the compressed air enters the discharge pipe at a pressure only slightly above the hydrostatic head, the column of water above is forced upward. Air continues to enter, filling up the space left by the rising body of water until the top of the water column reaches the discharge opening. The moment that a portion of the rising water is discharged, the weight of the column is thereby reduced, and the air beneath it will correspondingly expand, thus reducing the pressure on the water in the discharge pipe below the air inlet. The weight of the water in the well, outside of the discharge pipe, then forces the water upward into the pipe, stopping the inflow of air. The pressure in the air supply pipe is quickly re-instated by its connection with the supply, so that it again forces an entrance into the discharge pipe. This is repeated until the

whole discharge pipe, above the air inlet, is filled with alternate bodies of air and water, the combined weight of which is enough less than the water in the well to keep up a constant flow of water into the discharge pipe. As each body of air rises, the total weight above it grows less, so that it continues to expand until, when it reaches the discharge, it issues at atmospheric pressure. In this way a continuous flow from

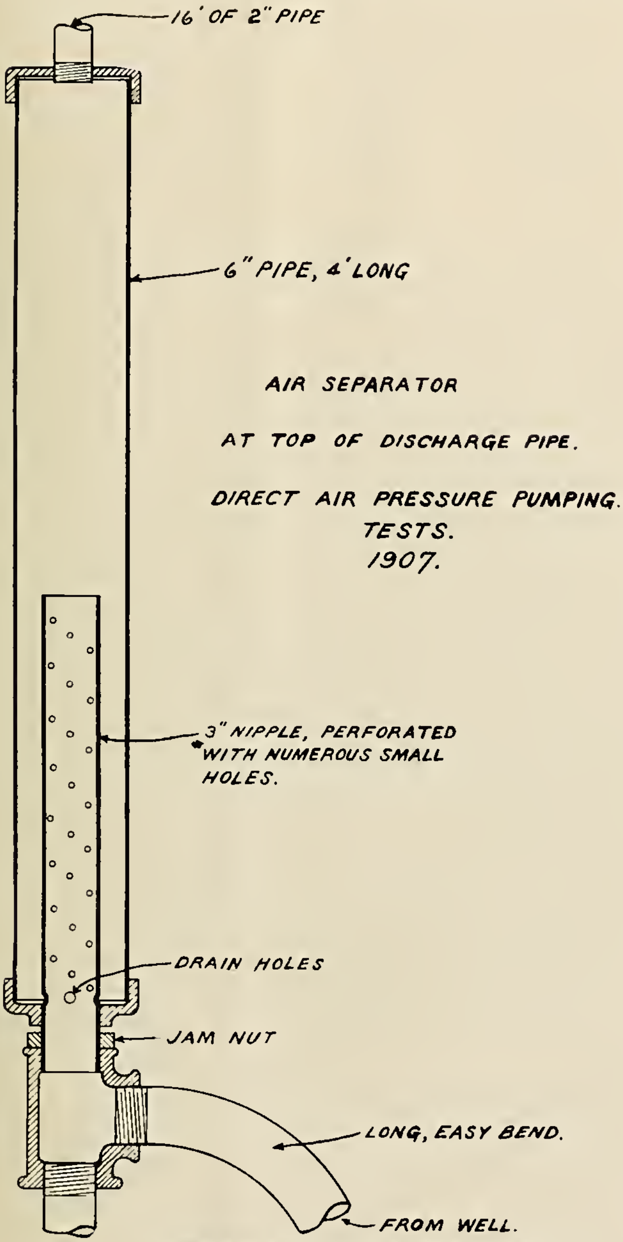


FIG. 2. AIR SEPARATOR AND TOP OF DISCHARGE PIPE.

the well is maintained as long as a sufficient quantity of air is supplied, and the capacity of the well is not overtaxed.

In this connection, it may be interesting to note that a model was made not long ago, of a deep well, having casing and discharge pipe in glass, for exhibition purposes. The above description of operation, deduced from the action of the test well, was entirely confirmed by the operation of this glass model, and, in addition, the cause of some of the losses encountered was learned.

The principal loss appears to be due to a slip back of a portion of each layer of water to the next succeeding layer, caused by the friction of the sides of the discharge pipe. Each change in diameter of the pipe, such as coupling or joints, materially increases this slip. Also, any obstruction or sudden bend adds to this loss.

The bodies of air are not clear, but are filled with bubbles and foam, caused by the presence of the water slipping back; but the bodies of water are clear and distinct.

In starting the well operation, it is necessary to admit air slowly into the well. The valve should only be opened a small amount, allowing the air to flow slowly, and gradually build up to the pressure required. After opening the valve, the pumping will not commence immediately, but several seconds, perhaps even a minute, will elapse before the water discharges, then it comes with a great rush. After this first rush of water there comes a lull for a few seconds, and then the pumping operation begins more uniformly. By opening the valve only a small amount, the air supplied will be a little less than required, and cause an intermittent flow from the well. The valve can then be opened gradually until the flow becomes continuous, which is the proper position in which to leave it.

OIL FUEL FOR SHIPS.

Consul John L. Griffiths makes the following report from Liverpool on the extending utilization of petroleum for ship propulsion:

The use of oil as fuel has engaged the attention of the British Admiralty for some time, and it has recently been decided to establish oil storage tanks in various parts of the United Kingdom to insure convenient sources of supply. Birkenhead, directly opposite Liverpool, has been selected as one of the supply centers. The experiments conducted by the Admiralty during the past twelve years were not at first satisfactory, and two adverse reports were made prior to 1902. Since then the tests have been of such a character as to reverse the original judgment of the Admiralty, and it may now be said that the importance of oil fuel is recognized by that body, and that its use will be extended in the future as rapidly as possible.

It is claimed that through the use of oil the number of men now required to do the stoking and trimming would be reduced by two-thirds, as the moving and stoking of the oil is automatically accomplished by steam pumps and pipes, instead of by stokers and trimmers as in the case of coal. While it is difficult with coal fires at full speed to maintain sufficient steam, it has been demonstrated that with oil fuel this difficulty would be overcome, and that when the speed is reduced the boilers are under such perfect control that the safety valves do not lift.

The oil, it is suggested, could be stored in the double bottom, now taken up by water ballast. In the case of the navy, one of the great advantages claimed for oil is the absence of a great volume of black smoke when vessels are proceeding at great speed and which serves to give information to the enemy. The evaporative value of oil is much greater than that of coal so that while forty-five cubic feet of bunker space is required for a ton of coal, only thirty-eight cubic feet is needed for a ton of oil. It will readily be seen how significant this difference would be to the great ocean-going steamers and how much space now set apart in them for the storage of coal would be released for cargo purposes and the accommodation of passengers.

The British navy has in service oil-using torpedo boats with a capacity of thirty-four knots. One of the drawbacks at the present time to the extensive use of oil fuel at sea is the high cost and the difficulty in many instances of securing it. The cost of oil in Great Britain has no doubt seriously interfered with its adoption for steamships and for a variety of industrial purposes. With a reduction in price the field for its employment would be greatly enlarged. The advantages of oil fuel briefly summarized are economy of space, absence of soot and cinders, elimination of the loss of time consumed in burning down and cleaning fires when coal is used, the ease with which oil can be bunkered, and the quickness with which a full head of steam can be generated.

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President

E. M. SCRIBNER, Vice-Pres. and Gen'l Manager.

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription 3.50.$ Foreign subscription, $4.00.

Subscriptions cannot commence with back numbers.

Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX JUNE 13, 1908 No. 24

EDITORIAL.

E. M. SCRIBNER.

As shown in the heading above, our readers will note that Mr. E. M. Scribner, for some years past connected with the Western Electric Company, has severed his connection with them, and become associated with the Technical Publishing Company, as vice-president and general manager. Mr. Scribner entered the organizaton of the Western Electric Co. in 1889, remaining in charge of their Supply Sales Department, at New York and Chicago, until 1896, in which year he acquired an interest in the Bryant Electric Co., of Bridgeport, Conn., and for six years devoted his time to their sales work. He then again took up his work with the Western Electric Company, in full charge of their general supply sales department, with headquarters at Chicago. In 1905 he located on the Pacific Coast, at San Francisco, in charge of their Pacific Coast interests, occupying at the same time the position of president and director of their several subsidiary companies. These services have eminently fitted him to carry on the work of the "Journal of Electricity, Power and Gas," to which he is a notable accession of strength. Thorough knowledge of the electrical business, and a wide acquaintance with electrical men throughout the country, give him an unusual command of the situation. A genial personality has won him many friends among former competitors, whose interests he will now seek to promote. His entrance to the field of journalism will but serve to more closely cement these friendly ties, and as an active representative he cannot fail to open up to Eastern manufacturers the electric potentialities of the West.

ELECTRICAL CONTRACTING TROUBLES.

Because of his intimate knowledge of his peculiar troubles, every man is likely to imagine that his own business is a little harder than his neighbors, and often the greater his difficulties the more suggestions he receives for their betterment. Therefore, while we feel justified in commenting upon the conditions existing in the business of electrical contracting, it should be kept in mind that such gratuitous advice is worth just what it costs.

In electrical contracting, as well as in many other lines of trade, exist the anomalous conditions of a high wage scale and many unemployed workers. But such artificial evasions of the universal law of supply and demand cannot last long. Wages must be reduced unless more work is provided. Journeymen are contracting at half rates to the detriment not only of legitimate contractors, but also of their fellow workers. Recognizing this fact, the union proposes to deny cards to members who engage in such practices. This expedient is temporary at best, for mere membership in an electrical workers' union is small solace to a man looking for a job. In San Francisco, for instance, there are something like three hundred journeyman electricians out of work. Every builder is besieged with proffers for cheap electric wiring, and in the case of many small jobs these grip-sack artists often land the contract.

Further business demoralization is caused by the plumbers' helpers and hardware salesmen, who consider themselves capable of installing electric systems. They are often little better equipped for such work than is a blacksmith as a prescription clerk. Their work is usually done in older buildings, which are not inspected and whose owners do not know of the municipal certificate requirement. To such carelessness is due much of the so-called fire hazard of electricity. Such reckless and shiftless work by "fake" wiremen is a danger that few realize.

They do not recognize the great strides recently made in electrical construction, and the elimination of the old idea that the mere ability to string a few electric-bell wires is the only requisite. Today electrical construction involves complicated problems and requires technical knowledge and skill that can only be acquired by experience. Furthermore, it is a business that properly involves large sums of money and a sufficient ability to get and to give credit. In an advisory capacity also, the contractor is familiar with the principles of illuminating engineering, and on his judgment depends the safeguarding of our eyesight. Such a high standard cannot be furnished by the helper and the "farmer," whose chief qualifications consist in their

cheapness. This short-sighted policy is, however, likely to prove the more costly in the end, and on its elimination depends satisfaction.

To remedy these evils there seems to be no more feasible plan than that of requiring a license as a guarantee of efficiency. Such a license should be granted only to those who may qualify by a written and oral examination to the requirements of a commission of competent electricians. As a further tender of good faith and responsibility, we would suggest a nominal charge or fee, to be collected from all contractors, and also that they be required to employ only licensed electricians.

PERSONAL.

C. W. Koiner is now general manager and engineer of the Pasadena, Cal., municipal lighting plant.

G. A. Wilbur, electrical manufacturers' agent, has moved to 564 Howard Street, San Francisco.

E. C. Bradley, vice-president and general manager of the Pacific Telephone Company, is making a business trip East.

Walter H. Inbusch, of the Pacific Telephone and Telegraph Company, has been transferred from Los Angeles to San Francisco, California.

Clem A. Copeland, electrical and mechanical engineer, of Los Angeles, has removed his office from the Citizens' National Bank Building to Suite 1400 Union Trust Building.

TRADE CATALOGUES.

Catalogue No. 22, from the Chicago Fuse Wire & Manufacturing Company, 170 South Clinton Street, Chicago, Ill., illustrates and describes "Union" switch boxes, outlet boxes and covers.

The Cutler-Hammer Manufacturing Company, of Milwaukee, has issued a 16-page pamphlet descriptive of their "Wirt Type" dynamo brush, designed for use with low-tension, direct-current motors and generators, alternating current generators, plating dynamos, exciters, etc. In addition to the descriptive matter and price list, the pamphlet contains useful information on the care of commutators and brushes.

CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an examination on July 8-9, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of fortification draftsman, Engineer Department-at-Large, San Francisco, Cal., at an entrance salary of $1,500 per annum, and vacancies requiring similar qualifications as they may occur. The examination will consist of engineering (including building materials and construction, elements of design in steel and reinforced concrete), topographic drawing, lettering and preparation of detailed drawings from sketches or descriptions, training and experience.

The United States Civil Service Commission announces an examination on July 1-2, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of hydrographic draftsman, $900 per annum, in the Coast and Geodetic Survey, and vacancies requiring similar qualifications as they may occur in any branch of the service. The examination will consist of projections, mathematics, hydrographic surveying, etc., drawing and lettering, training and experience (rated on application).

TIMBER IDENTIFICATION.

It is doubtful if any of the laboratories maintained by the government for scientific research are more unique in character, and yet bear promise of more important results, than one which has just been established in Washington by the United States Forest Service for investigating the structure of commercially important woods. Laymen will not understand the significance of the proposed investigations carried on in this laboratory so quickly as architects, builders and other wood users, who, in these days of growing scarcity of the more valuable woods, are seriously perplexed in identifying substitutes. Mistakes of this kind in identification have, in the last few years, in several instances, meant the loss of thousands of dollars, and many embarrassing law suits.

Nearly any user of lumber can recognize, and name offhand, all the usual trees of the forest when he sees them growing, and not much difficulty is encountered in identifying the common kind of lumber in a mill yard, because he knows the few trees from which the yard lumber comes. But common kinds are growing scarce, and woods not often cut heretofore, are appearing in the markets. The most experienced men are sometimes puzzled when they try to identify them, and persons with less experience have still more trouble. Is a certain wood gum or elm? Is another cucumber, linn, or poplar? Is a stick sugar maple or red maple? Doubts may arise whether a piece is hemlock or spruce, or whether it is lodgepole pine or fir, or whether a shingle is cypress or cedar. A dealer may buy red oak and suspect that he is getting something else. There are thirty or more important species of oak. The best lumber dealer might not know which is which in the lumber pile, or if he knows, he might not know how to prove it.

Many of these woods look alike, even to the trained eye of the millman or the builder, and yet they are widely different in value for certain purposes, and it is of the greatest importance to be able to distinguish them quickly and certainly. Again, a new wood may come to a man's notice for the first time, and it may be necessary for him to decide what it is and what it is worth.

The government has been helping individual lumber users for some time, but the facilities have not been near so complete as they are now. It is to meet such needs and answer such questions, that the Forest Service has established the laboratory, and placed it in charge of a trained dendrologist. Architects, lumbermen, manufacturers and makers of woodware are already sending in samples of wood for identification, and asking if there are not some structural characters by means of which such woods may be conveniently separated for relative species having greater or less value for some specific purpose.

The laboratory will investigate in a practical way. The structure of the woods, sections lengthwise and crosswise, will be studied so as to separate by structure alone the various species of a genus. Analytical keys to the trees of each group will be worked out. These will be based on the arrangement and character of the pores discernible to the naked eye, or by a hand lens.

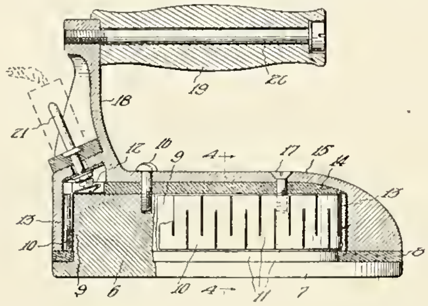
The results will be published from time to time with good illustrations and placed at the disposal of lumber users. After all the important groups of wood, such as oaks, pines and firs, have been studied and the results published separately, the several monographs will be collected and published in one volume.

A work of this character has long been in demand by architects, builders and other users of lumber. It will, in most cases, enable even a non-technically trained man to determine quite readily the wood he deals with by means of an ordinary hand lens, and by comparing the wood in question with the photographs of cross and long sections given in these monographs.

PATENTS

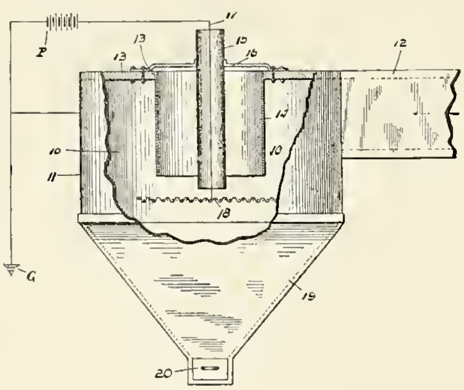
ELECTRIC FLAT-IRON AND CONDUCTOR. 888,843. Paul E. Oswald, Los Angeles, Cal.

An electric flat-iron comprising a body having a ledge at the bottom thereof, a heat and electric insulating washer on said ledge, a sheet of insulating material above washer and around body, a compressed graphite ribbon having staggered slits in its opposite sides exterior insulating material, con-



tacts secured to the ends of ribbon, heat and electric insulating material exterior ribbon, and within slits, heat and electric insulating material upon body and conductor, a cover for body and conductor having a handle secured thereto and contact posts secured to and insulated from the cover and engaging the contacts secured to the conductor.

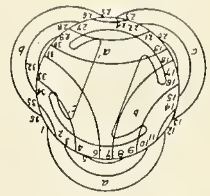
APPARATUS FOR ELECTRICAL SEPARATION OF PARTICLES FROM A FLUID STREAM. 888,638. Lawrence N. Morscher, Enterprise, Kas., assignor to William J. Ehrsam and Lawrence N. Morscher, co-trustees, Enterprise, Kans.



An apparatus for separating particles from a fluid stream comprising, a pair of electrodes to be electrically charged at different potentials and arranged one within the other with an annular separating chamber in the field of electrodes having an induction passage leading thereinto, chamber also having a fluid-eduction passage leading therefrom, and a non-charged member arranged to receive the precipitated particles.

ARMATURE-WINDING FOR ELECTRICAL MACHINES. 888,514. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.

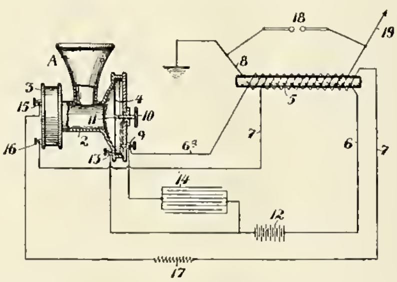
A winding for polyphase electrical machines comprising a plurality of groups of coils for each phase of current that



induce corresponding opposite magnetic poles approximately 180 electrical degrees apart, the sides of the coils of each group alternating in position with the sides of those of other groups that correspond to the other phase or phases of current.

WIRELESS TELEPHONE. 889,031. Francis J. McCarty, assignor to McCarty Wireless Telephone Co., San Francisco, Cal.

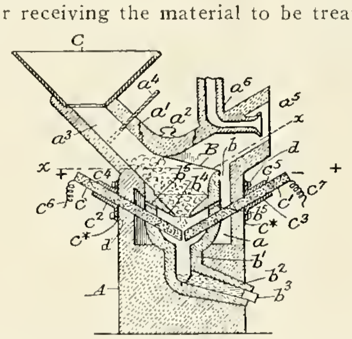
In a wireless telephone, means for intensifying the vibrations from a transmitting device, means consisting of a transmitting diaphragm with metallic contact points, an opposed



microphone transmitter, an induction coil including two primary, and a secondary winding, one of primary windings being connected with the diaphragm, and the other with the microphone, a local battery, connections there-through with the coil, a spark-gap interposed in the secondary circuit, and aerial and ground wires connected with secondary wire.

ELECTRIC FURNACE. 888,877. Leon Dion, Wilkes-Barre, Pa., assignor to The Americus Electro-Hermetic Company, Wilkes-Barre, Pa.

The combination in an electric furnace, with an inclosing structure provided in its interior with a chamber, of a bowl or crucible for receiving the material to be treated, arranged



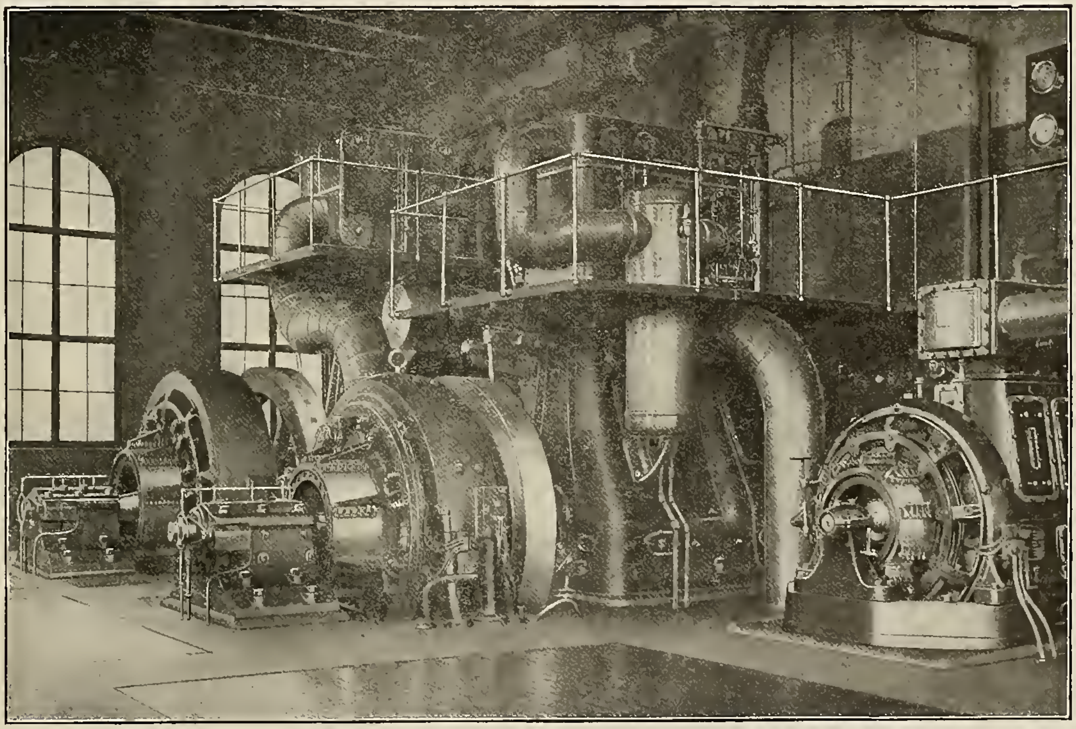
in such chamber and provided with a contracted lower chamber portion to receive the metal or other material when fused, and electrodes, adapted to be connected with a source of electric supply, arranged to project into the bowl or crucible and across the path of travel of the material being treated as such material passes downward through the bowl or crucible.

INDUSTRIAL

COMPOUND ENGINE GENERATING SETS.

The most important consideration in the design of the power plant is the type and size of the main engine or generating set. Even though the apparatus for the generation of steam is economical, the total amount of steam used by the engine is the real factor that determines the size of all the apparatus as well as the amount of fuel burnt in a given time. In some sections of the country the price of fuel is so great that owners of manufacturing plants endeavor to get their power and light at the least possible cost, and most manufacturers realize that it is better to increase the first cost in clearances and using gridiron valves with an auxiliary or cut-off gridiron valve on each steam valve. These sets made up of compound engines and Sturtevant direct-connected ten-pole generators are especially adapted to small electric-lighting plants and industrial establishments. They are of medium speeds, and being vertical require but little floor space, thus permitting the power house to be erected at minimum cost. They were originally designed as condensing engines, but can, of course, be run non-condensing.

In addition to the advantages as regards economy, the Sturtevant generating set is designed for continuous operation with little or no attention. To accomplish this, all moving



INSTALLATION SHOWING THREE STURTEVANT GENERATING SETS. 100 K. W., 250 K. W., AND 400 K. W.

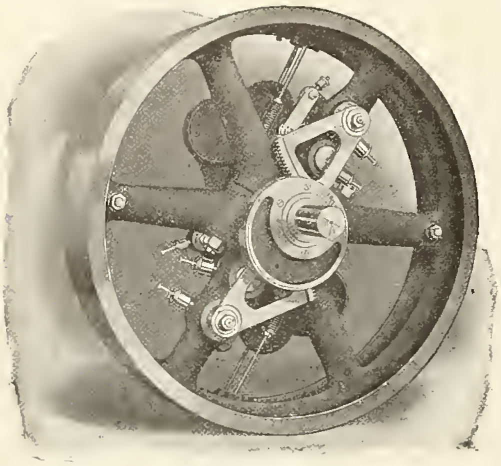
order that a continual saving may be effected as long as the apparatus is in use. For this reason it is usual to purchase a compound engine if the plant is of any considerable size.

For many years the B. F. Sturtevant Company has been supplying generating sets in small sizes, apparatus which has proven of great success. This is shown by the fact that the Sturtevant generating sets of 50 to 100 kilowatt capacity are frequently installed in the vessels of the United States Navy, the rigid specifications, as drawn up by the government, making it difficult for any but high-grade sets to receive consideration.

The B. F. Sturtevant Company has added to its line of generating sets by increasing both the number and the capacity. Sturtevant generating sets from 150 to 500 kilowatts with compound engines of the four-valve type show remarkable economy. This is made possible by reducing the parts, except some portions of the valve gear, are entirely enclosed, and watershed partitions, placed between the frame and the lower cylinder heads, prevent water from the stuffing boxes mingling with the oil in the frame, and also making it impossible for oil within the frame to enter the cylinder on the piston rod. All wearing surfaces within the frame are supplied with an abundance of oil by means of a system of forced lubrication. With this system a small direct-acting pump forces oil through passages in the moving parts and through small pipes to the crank pin, wrist pin, crosshead guides, etc. The same system supplies the outboard bearing.

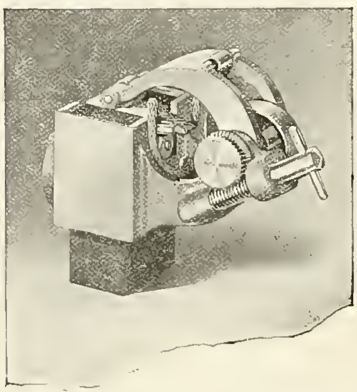
The generators are of the Sturtevant ten-pole type, direct-connected to the engine shafts by a flange coupling. They are designed for a wide range of load, and require little or no attention. Ample cooling surfaces and mechanical ventilation render the generators free from heating and burn-outs.

These machines are capable of carrying an overload of 33 1-3 per cent for two hours without injurious sparking, and an overload of 100 per cent momentarily without destructive

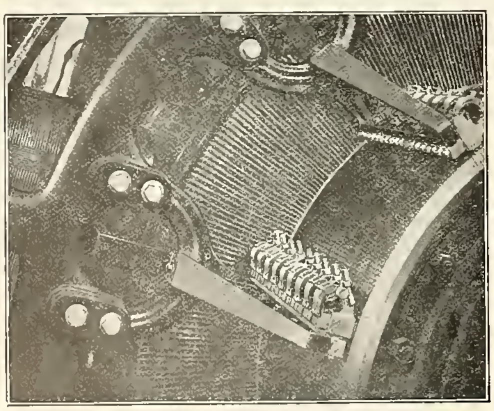


GOVERNOR.

sparking or heating. The insulation will not deteriorate after continuous operation at normal temperature. At maximum



temperature, the insulation resistance between the windings and the frame is tested at alternating pressure of at least 1,500 volts at 60 cycles for a period of 60 seconds.



BRUSH.

The armature is of the iron-clad, drum-wound type, the core being built up of sheet steel segments, clamped between end flanges and provided with vanes which maintain a constant blast of air over the surfaces of the winding. The armature is multiple-wound and provided with cross-connecting rings, so that all brushes of the same polarity are maintained at the same potential, a feature that insures a uniform pole strength.

The commutator, mounted on an extension of the armature, is built up of drawn copper segments, which are insulated with amber mica of the best quality, of a thickness that makes impossible an accidental breakdown. So perfect is the commutation of these generators that the necessity of turning off the commutator is a very remote possibility.

Carbon brushes of a size that current density will never exceed thirty amperes per square inch, are held in the latest design of sliding-socket shunt brush holders, which are clamped on a composition frame, insulated from the brush ring itself. Each brush holder can be adjusted separately and removed for cleaning and repairs, or the entire brush ring may be rotated by a hand wheel.

A NEW ASBESTOS INSULATING MATERIAL.

Asbestos Wood, a recent product of the H. W. Johns-Manville Co., is now being largely used as an electrical and fire-proof insulating material. Many advantages are claimed for it over marble, slate, fibre and wood, for switch boards, switch bases, insulating pieces, etc., as well as for general fire-proof construction. It is easily worked with wood-working tools and can be sawed, nailed or screwed the same as hardwood lumber. It is absolutely fire-proof, making it especially desirable for all construction where there is danger of short circuits.

One of the many applications of Asbestos Wood is in the construction of doors in front of high voltage transformers and switches in high tension stations, where an absolutely fire-proof and insulating material is essential.

The insulation resistance is extremely high, being almost equal to that of sheet mica, which is the best insulating material known. Asbestos Wood has a smooth surface and will take any kind of finish that may be desired. For electrical purposes it is regularly furnished in Ebony finish. The H. W. Johns-Manville Co., of New York, have recently issued a booklet fully describing this product.

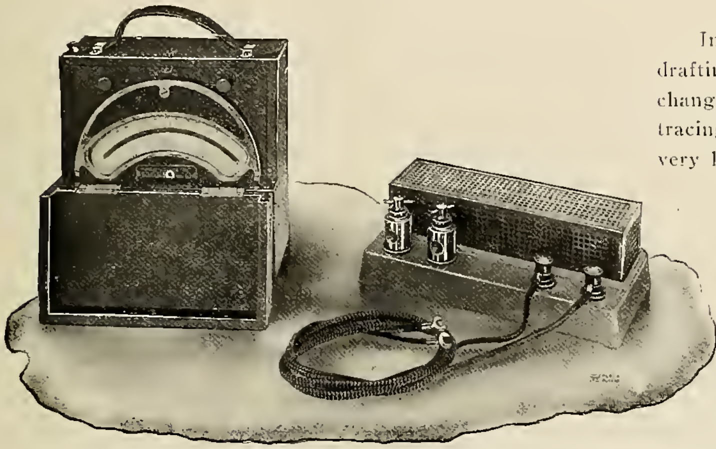
A NEW RAILWAY MOTOR PINION.

The General Electric Company, Schenectady, N. Y., reports that the remarkable properties which are exhibited by the new Grade F pinion now being placed on the market have caused a number of railways to introduce it in various classes of service. The physical characteristics of tensile strength and elastic limit are greatly in excess of those ordinarily found in this part of the equipment, and the claim that one of these pinions will outlast three ordinary pinions is apparently well founded.

As the vital factor of gear economy is the maintenance of the correct outline of the teeth, it is frequently, if not generally, necessary to replace the pinions two or three times during the life of a single gear. The substitution of Grade F pinions for the ordinary soft pinion will, therefore, eliminate all the expense for these renewals as well as prevent the inefficient operation of pinions with worn teeth. Worn pinion teeth produce among other evils an increased demand on the power station, excessive wear on motors and trucks, and a highly objectionable noise. Even without the economy in renewals, therefore, a pinion having a life approximately equal to the gear is a good business investment. The General Electric Company is furnishing the Grade F pinion on all new equipments.

A NEW LINE OF DIRECT CURRENT PORTABLE INSTRUMENTS.

A new line of direct current portable instruments, known as Type DP, has been placed on the market by the General Electric Company. This type of instrument has been designed especially for laboratory and general testing purposes, and includes a complete line of ammeters, voltmeters, milammeters and milli-voltmeters, with the necessary portable shunts. These instruments are constructed on the well-known D'Arsonval principle, the coil of wire carrying the current to be measured, or a shunted portion of it, being wound on a rectangular frame mounted on jeweled bearings. This frame is free to move in the annular space between a soft iron core and the pole pieces of a powerful permanent magnet.



The case enclosing the mechanism of the instrument is of drawn steel with a cast iron cover, thus thoroughly protecting the instrument from the influence of stray fields. The magnets used are of the highest grade of magnet steel obtainable, and their permanency is assured by improved processes of aging and hardening. High torque is secured through efficient design. The scales are uniform throughout their entire range, and are very legible. To eliminate errors due to parallax, the instruments are equipped with flat pointers viewed on edge, and a mirror is placed under the scale.

Ammeters are made self-contained in capacities up to and including 30 amperes. For higher ranges up to 2,000 amperes a milli-voltmeter with scale marked directly in amperes is used with a portable shunt. These shunts are designed to give a uniform drop of 200 milli-volts at full load rating, and are, therefore, interchangeable. The milli-voltmeters used with these shunts are also interchangeable. The portable shunts are mounted on a base of aluminum alloy and are protected by a perforated sheet metal casing. This gives a very light and durable construction. They are furnished with a leather handle to facilitate transportation. If desired, two or three shunts can be furnished combined in one case.

When an instrument is desired for a class of work which does not require extreme precision, a DP milli-voltmeter can be furnished for use in connection with switchboard shunts, the instrument giving full scale deflection when subjected to a 60 milli-volt drop in potential, or a tap may be brought out at 60 milli-volts on the standard 200 milli-volt voltmeter, enabling it to be used with both portable and switchboard shunts. Where it is desired to use one instrument to cover a wide range of current, a milli-voltmeter can be furnished for use with any combination of single, double or triple rated shunts. The standard capacities of the portable shunts have been so selected that regardless of which capacities are chosen, the scale readings may be quickly determined.

Voltmeters of the DP type are furnished self-contained in capacities up to and including 750 volts. Double scale instruments can be supplied if desired. For measuring very low voltages and currents DP instruments can be furnished with the scales marked in milli-volts and mil-amperes. As shown in the illustration this type of portable meter is very neat in appearance. The carrying case is of mahogany, and all metal parts have oxide finish with nickel trimmings.

MOTOR-DRIVEN ERASER.

In even the most careful work in engineering offices and drafting rooms, mistakes will occasionally be made and changes are frequently necessary, requiring alterations in tracings. It is well known by draftsmen that erasing with a very light fast motion will remove the lines without a scar, but most draughtsman do not have the patience to do the work without putting too great a pressure on the rubber, and the result is a marred tracing. The use of a scratcher leaves the poorest job of all. For these reasons an eraser driven by a small electric motor finds great favor among draughtsmen. If desired, the motor may be carried from table to table, as its weight is but little. In some cases a separate bench is used for erasing, and all tracings, etc., requiring correction are brought there.

The motor is supplied for either direct or alternating current, 1/12 or 1/8 horsepower. The high speed of the motor gives the circular eraser the required high speed so that but a light pressure is required to remove any line desired. The tendency of men unfamiliar with the use of these erasers is to put too heavy a pressure on the eraser. This results in overheating the paper, and in some cases may injure it enough to spoil the drawing. But with a little practice any one may readily learn to use the eraser very rapidly and accurately. The complete outfit is supplied by the Coates Clipper Manufacturing Company of Worcester, Mass.

AMERICAN CYANAMID PLANT.

The contract for the construction of the first cyanamid plant on this side of the water has been let by the American Cyanamid Company to Westinghouse, Church, Kerr & Co., of New York City. The plant is at Niagara Falls on the Canadian side. The initial capacity will be 7500 tons per annum. There are eleven cyanamid plants in Europe, projected, in process of construction, or in operation, and their aggregate annual capacity is 166,000 tons. Inasmuch as America supplies a considerable portion of the feed stuffs for Europe, it is likely that the expansion of the American plant for the purpose of agricultural fertilizer will be very rapid.

Dossert & Co., 242 West Forty-first Street, New York City, have received orders from Walter Kidde for 2-way connectors, cable taps, and terminal lugs for use in the wiring of the plant of the American Hard Rubber Company, College Point, L. I.

NEWS NOTES

INCORPORATIONS.

Oakland, Cal.—The Daisy Oil Company, capital stock, $500,000, has been incorporated here. F. E. Horton and A. A. Bussey, of Oakland, and W. J. Rhoads, Jr., of Stockton, are directors.

San Francisco, Cal.—The Federal Oil Co., capitalized at $1,000,000, has been incorporated here. Shares are $1 each, and stock has been subscribed by J. Barneson, N. H. and I. H. Frank, and C. A. Shuey.

Los Angeles, Cal.—The Submarine Oil Co. has been incorporated with a capital stock of $1,000,000,000. The directors are H. B. Pearson, F. N. Burger, D. S. Elder, G. A. Carter, J. M. Eshelman, and P. P. Hovey.

Billings, Mont.—The Hardin Water & Power Co., composed of citizens of Hardin and Billings, has been organized for the purpose of supplying both electricity and gas for lighting purposes, and also water for all purposes, to the town of Hardin. The company is capitalized at $30,000.

San Francisco.—The Union Electrical Manufacturing Company has been incorporated with a capital stock of $50,000, shares $1 each. Fifty shares have been subscribed by A. A. Clue, while L. G. Copeman, G. M. Fisk, P. A. Clifford, and F. J. McNulty subscribed ten shares each. Place of business, San Francisco.

Los Angeles, Cal.—Articles of incorporation have been filed by the Long Beach Inner Harbor Gas Co., with a capital stock of $500,000. Among the directors of the company are Horace M. Dobbins, Pasadena, and F. W. Stearns, Long Beach. This company is a consolidation of the Long Beach and Inner Harbor Gas Companies.

Spokane, Wash.—The Orient Water Power Co. has been organized by Spokane capitalists, for the purpose of generating electricity for power. Arthur Phillips is president, Col. E. D. Sanderson vice-president, and Wm. Davidson secretary. Plans have already been made for a $75,000-plant, to be erected at Orient, and preliminary plans drawn for another plant, to be located in Ferry County.

ILLUMINATION.

Madera, Cal.—John F. Beales, of Los Angeles, has been here for the past week looking over the field with the view of installing a gas plant.

Riverside, Cal.—The Banning Home Gas Company has filed plans and specifications for its plant to cost $14,500. The contract has been let to J. R. Thompson of Los Angeles.

Pasadena, Cal.—On June 2d the City Council approved the electric lighting supplies appropriations, and contracts were awarded to the Maloney Electric Company and to the Westinghouse Company.

Los Angeles, Cal.—The amalgamation of the Long Beach and the Inner Harbor Gas Companies is expected to result in a much superior service. The companies have already joined their mains, and are expected to make some important extensions.

Richmond, Cal.—City Attorney Hart has made the statement that if the Board of Trustees will grant a franchise and if the field is found to be unmonopolized, a Santa Clara capitalist will soon lay mains to this place and supply the city with gas for fuel and lighting purposes.

Petaluma, Cal.—E. C. Jones, of San Francisco, chief engineer of the gas department of the California Gas & Electric Corporation, and Sherwood Grover, assistant engineer of the company, were here the last week in May, inspecting the gas system of the Petaluma Gas & Electric Company, with the view of making some improvements in the near future.

San Francisco.—The Permanent Down Town Association, composed of the merchants and property owners of the Market Street district, is going to erect serviceable and artistic lighting poles in the district bounded by Market, Powell and Sutter Streets, at an expense of about $20,000. The poles will be presented to the city supervisors, who have agreed to furnish the lights. There will be six poles to the block, each pole supporting five globes.

San Francisco.—City Attorney Long has advised the commission on electricity that it had no power to remove the chief of the department of electricity and make a new appointment unless under the civil service provisions of the charter. Long holds that Hewitt is a civil service employee and that he cannot be removed unless given a trial after charges have been filed against him. The commissioners, for some time, have been considering the advisability of removing Hewitt, as they were not satisfied with his management of the department.

WATERWORKS.

San Francisco.—The time of opening the bids for the new government pumping plant at the Presidio in this city has been postponed until June 20th.

Santa Clara, Cal.—The city supervisors have decided on improving the municipal water system. A contract with the G. E. Dow Pumping Engine Company for new machinery to the amount of $7,124 was awarded. The system of mains will also be extended.

Oroville, Cal.—At a recent meeting of the City Trustees where water irrigation was discussed, the water company agreed to put its system in such a condition within a year as to give satisfactory service for this purpose. Provisions for repiping the city were also made.

Los Angeles, Cal.—The Board of Public Works has approved the specifications of the work on the most difficult parts of the Los Angeles aqueduct in what is known as the Jawbone section. The city will give private contractors an opportunity to bid on the work, and if they make satisfactory offers the work will be conducted under private contracts in this section.

TRANSMISSION.

Exeter, Cal.—The Mt. Whitney Light & Power Company will soon begin the erection of a sub-station here.

Centralia, Wash.—Local interests have secured options on the exchanges of the Sunset Telephone Company at Centralia and Chehalis. If the deal is closed the Centralia men will build an entirely new and up-to-date exchange.

Oroville, Cal.—The Great Western Power Company has commenced the erection of an immense dam at the intake of its tunnel. It will be 125 feet high and will turn the river through the tunnel to the company's power house at the lower end of the tunnel. Engineer Veile expects the Great Western plant to be supplying power to many of the nearest towns by October.

Baird, Shasta County, Cal.—William Ellery, of Redding, has filed on 124,000 inches of water of the McCloud River at a point near here for the purpose of generating electricity for power. This is the largest water location ever filed in Shasta County. The notice states that the water will be diverted from the river at a point in Sec. 5, Tp. 35 N., R. 3 W., and thence to the power house to be located on Section 9.

Seattle, Wash.—The regents of the University of Washington have postponed the awarding of the contract for the erection of the proposed power house for the university. The lowest bid for the structure was that of H. Chase & Co. of $15,907, and for machinery that of the Hallidie Machinery Co. at $72,900. It is probable that some time will elapse before the final awards are made.

Oroville, Cal.—J. W. Goodwin, president of the Oro Light, Water & Power Company, has issued a statement to the Chamber of Commerce, in which he sets forth that his company has spent about $500,000 in improving its system and is contemplating the spending of $50,000 more. The report also states that the company is contemplating the reduction of the power rates in the near future.

San Jose, Cal.—Prof. John J. Montgomery, who formerly gained some notice as an aeroplane builder, has completed the invention of an apparatus which he claims will supplant the skilled operator in the telegraph office. The contrivances are planned to transmit and receive messages and to relay them by a system of machines with typewriter keyboards, the receiving instrument automatically printing the message as it is sent. The ability to give the sending and receiving instruments a certain tension which will make wire-tapping impossible is one of the features of the new invention. The Telautoprint Company, of San Francisco, will try to interest the big companies in the machine.

TRANSPORTATION.

San Bernardino, Cal.—Last week the county supervisors sold to John H. Fisher, of Redlands, the franchise of the Central Railway, from the city limits of Redlands to Redlands Junction.

Stockton, Cal.—The Central California Traction Company has applied for a franchise for an electric road in this city. The matter will be taken up by the city trustees at a meeting to be held June 15th.

Los Angeles, Cal.—The City Council has authorized the opening of Fifth Avenue, between Castillo and Bath Streets, in order to provide for the extension of the street railway system to the entrance of Oak Park.

Ventura, Cal.—Julian P. Jones and Frank M. Packard, the owners of the franchise for an electric road between this city and the Ojai and Matilija, have arrived here and are making necessary arrangements for the preliminary work on the line.

Redding, Cal.—The Northern Electric Light & Power Co. was awarded a franchise to erect poles and string and maintain wires in the corporate limits of the city at the meeting of the trustees on June 2d. The franchise is for a term of fifty years.

Huntington Beach, Cal.—Col. H. S. Finley, of Santa Ana, has assured the citizens of this section that the Pacific Electric Railway intends to extend the line which is to be built from Huntington Beach to the cannery near here on to Santa Ana by the way of Talbert.

Pasadena, Cal.—The Lincoln Avenue Improvement Association of this city met recently and decided to give one more week's time to the committee which is trying to interest the H. E. Huntington interests in the extension of the street railway system on Lincoln Avenue.

Los Angeles, Cal.—Last week the City Council agreed that a franchise would probably be granted for a cable road up Avenue 43 to the Mount Washington District. The property owners of this district, west of Marmion Way, are opposed to the cable railway being built on their street, and on May 29th petitioned the council not to sell the franchise asked for.

Baker City, Ore.—During the summer it is the intention of the Grand Ronde Electric Company to construct about thirty-three miles of road from Union to make connection with the Rock Creek line in Baker County. The road will connect with the power lines of the Fremont Power Company, thus insuring an abundance of power. The estimated cost of construction is $50,000.

FINANCIAL.

Pasadena, Cal.—The water companies of this place state that it is hoped a bond election for $1,000,000 for the purpose of acquiring water plants, will be called soon.

Santa Barbara, Cal.—The City Council recently adopted resolutions calling for a vote at an early date on the proposed bond issue of $200,000, for the completion of the water tunnel at that place.

Dinuba, Cal.—The City Clerk has advertised the sale of the bond issue of $20,000 for the purpose of erecting a municipal waterworks plant. The bonds are of $1,000 each, and bear 5 per cent interest.

Vallejo, Cal.—At the election held at Vallejo, Cal., on June 2nd, the bond issue carried by a large majority. The bonds, to the amount of $85,000, are for money to increase the municipal water system.

Los Angeles, Cal.—The city of Los Angeles is offering for sale municipal bonds to the amount of $340,000, which have been authorized for the construction of the Los Angeles aqueduct. The denomination of the bonds is $200, with interest at 4 per cent, payable semi-annually. The City Council held a special adjourned meeting on June 2nd to pass some legislation relating to the bond sale.

TELEPHONE AND TELEGRAPH.

Ephrata, Wash.—A telephone line is being planned to connect Ephrata with Soap Lake. The Farmers' Mutual is behind the project.

San Francisco, Cal.—The ordinance regulating the rates to be charged by the telephone company during the coming fiscal year has been passed to print by the Supervisors by a vote of 15 to 1.

Mount Vernon, Wash.—A franchise was granted to R. J. Kellogg, of Baker, for the construction and maintenance of a telephone system over and along the county roads between Sedro-Woolley and Baker.

Palouse, Wash.—At a meeting of the Garfield-Palouse Telephone Company held at the Herman Curtis place, it was decided to rebuild the line, and with that end in view, poles and wire have been ordered.

New Westminster, B. C.—Workmen commenced operations this week on the erection of a long-distance telephone line from this city to Hammond, Haney, Whonnock, Ruskin, Mission and other points along the north bank of the Fraser River. The line is being built for the British Columbia Telephone Company.

Honolulu, H. T.—The franchise of the Standard Telephone Company will expire on June 20th, but arrangements are being made to have it extended, so as to allow a little more time before the work is started. In the event of the extension of time not being granted, the company will ask for a new charter and franchise and reorganize.

Tacoma, Wash.—In the Federal Court, June 1st, damages of $3,750 were awarded to A. Parmenter in his suit against the Pacific States Telephone & Telegraph Company. A logger felled a tree which struck the wires that pulled down a telephone pole that broke the shoulder of Parmenter, who was driving on the Thurston county road. Damages in the sum of $10,000 were asked.

FINANCIAL.

The Sunset-Monarch Oil Company has levied an assessment of 10 cents per share, delinquent June 18th, sale day, July 7th.

The Union Oil Company will hold a meeting of stockholders August 20th in Los Angeles to act upon a proposition to increase the capital stock to $50,000,000.

Salt Lake, Utah.—By the filing of a $10,000,000 trust deed a few days ago, the Telluride Power Company indicates its intention to begin an extensive improvement of its system in Utah, Colorado and Idaho.

San Diego, Cal.—The William R. Staats Company, of Los Angeles, has received its second consignment of city bonds, having paid the money over to the City Treasurer, and received the bonds a few days ago.

Los Angeles, Cal.—Another installment of Los Angeles aqueduct bonds has been received from the American Bank Note Company. It comprises an issue of $340,000, in denominations of $200. The bonds are known as "Series D."

Yuba City, Cal.—At a meeting of the City Trustees, held on June 1st, it was ordered that an election be held on June 30th, for the purpose of deciding the question of bonding the city for $30,000 for the erection and equipment of a municipal water works system.

Gridley, Cal.—The Board of Trustees at a meeting last week voted unanimously for a resolution declaring the need of a municipal water system and electric lighting system. They set forth the fact that it will be necessary to bond the city for these improvements.

OIL.

Salinas, Cal.—The Associated Oil Company is planning for the improvement of its plant here by the installing of its own tanks and machinery in the yards, so as to facilitate the handling and shipping of its products.

Bakersfield, Cal.—The Adeline Oil Company has struck a fine flow of water in the Sunset district while sinking a well. The flow at present is about 30,000 barrels per day. The great scarcity of water in this district makes the strike an important one, and if the flow of the well does not diminish, the water question will be solved there to a great extent.

Coalinga, Cal.—There is a rumor that the proposed pipe line from Coalinga to Mendota will not be constructed immediately as the production does not warrant it. The oil which is now produced is being handled without difficulty by the Coalinga Oil & Transportation Co.'s pipe line to Monterey, which has capacity of 12,000 barrels daily, and the Southern Pacific oil trains, which take out about forty cars a day, and the Standard pipe line with its capacity of 20,000 barrels.

Florence, Cal.—J. T. Wallace, vice-president and director of the United Oil Company, one of the largest drilling and refining concerns in the West, has filed a suit against the company on behalf of himself and other stockholders, for the sum of $1,000,000, and has asked that a receiver be appointed for the company. The complaint alleges that the United Oil Co. has been mismanaged and that there have been illegal combinations and collusions with the Standard Oil Co., the Continental Oil Co., and other persons and incorporations.

San Francisco.—The report that the Standard Oil Company has offered $20,000,000 for the Coalinga properties of the California Oil Fields, Ltd., has been officially denied by D. E. Scofield, vice-president of the Standard Oil Company, who denied that any negotiations for the property were under way on the part of his company. There is a persistent report that some company, whether it be a subsidiary company of the Standard or not, is in the field for the property. The holdings in question are very valuable and surround property of the Standard Oil Company on three sides.

Los Angeles.—Work has begun to make the old Southern Pacific tracks from Sentous to Port Los Angeles, a part of the Los Angeles-Pacific trolley system. General Superintendent Robert P. Sherman stated recently that electric cars will be in operation over this new line the first week in July.

THE
Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., JUNE 20, 1908 No. 25

BOILER EXPLOSION ON U. S. S. "TENNESSEE."*

By CLEM A. COPELAND.

At eleven o'clock and eight minutes, in the morning of the fifth of June just passed, as the United States Armored Cruiser Tennessee was approaching Hueneme on its semi-annual speed test, the lamentable accident, already heralded in the daily newspapers, occurred by the rupturing of a boiler tube, next to and just above the fire, which blew fire and steam out into the boiler room with terrible force and destruction to life. The explosion caused the death of eight brave men and the serious injury of six others, who will undoubtedly recover.

Technical interest centers in the primal cause of the accident and its special bearing on the question of high pressure steam for central station work and allied important points in boiler design. The Tennessee is one of the most powerful vessels of the Navy, having a displacement of 14,500 tons, and being designed for a speed of 22 knots, and 25,000 horsepower. She is 502 feet in length, of 73 feet beam, and draws 26½ feet of water. There are contained in its sheath of five and nine-inch armor, sixteen "double" boilers and two triple expansion engines.

The boilers, designed for the normal gauge pressure of 300 pounds, are of the Standard B. & W. type for marine service, furnished for the Cramp's Shipbuilding Company as contractors. The type of boiler, as seen by accompanying diagrams, will be recognized by San Franciscans, as similar to those installed by the "Examiner" several years ago, and which for some time were to be seen in the wreck of their building, caused by the great San Francisco disaster. This boiler is admirably designed to economize in room, and is therefore suitable for isolated plant and navy use. Although designed for 300 pounds, the normal working pressure is 265, 400 pounds being the initial test hydraulic pressure imposed by Government specifications. On the trial acceptance run of the vessel, 283 pounds were used. Forced draft by means of air injected into an air-tight boiler room, containing two boilers, precluded the escape of the unfortunate men at the time of the accident.

FLAGSHIP TENNESSEE CALIFORNIA WASHINGTON
WARSHIPS AT ANCHOR IN SAN PEDRO HARBOR.

At 9 a. m. the vessel left Santa Barbara with ten boilers in commission, and at 9:30 the sixteen were put in service. After some time the pressure was raised to 265 pounds, and all the boilers were furnishing their normal supply of steam, and a speed of eighteen knots was attained, the vessel having its hull somewhat fouled, it being some time since it had been cleaned in the docks.

The engines are so designed as to admit high pressure steam into the intermediate cylinders, and it is thus a problem of considerable nicety to adjust the boiler steam supply to the amount which is to be admitted into the intermediate cylinders to obtain maximum speed of the vessel. In an effort to raise the speed, steam was in this manner being admitted to the intermediate cylinders, thus drawing off a large supply of steam from the boilers, the pressure dropping to 235 pounds with a vessel speed of twenty knots or twenty-three miles per hour, when the accident happened.

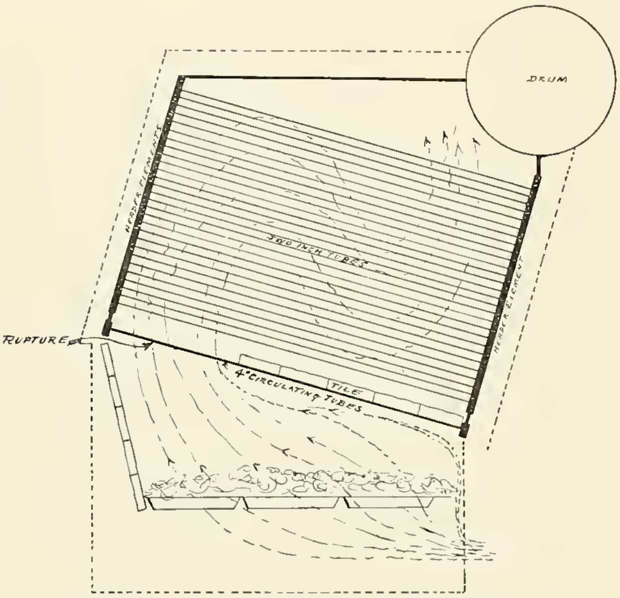
During the early part of the run, the boiler room doors were left open while the draft blowers were working, but to give maximum draft, the boiler room doors were closed a short time before the accident, the air pressure in the fire rooms being raised to about one and one-half inches of water. A mixture of Pocahontas and New River coal was being used, and although these are soft bituminous coals, giving a long flame, it is probable that the rupture occurred in the hottest part of the furnace, where the apex of the flame first impinged on the boiler tubes.

It is seen in the diagrams, that the tube gave way in the hottest part of the tube on the under side next to the fire, about eighteen inches from the rear end of the tube, the other end being covered with a tile diverting partition, under which a certain proportion of air enters. Steam was thus blown down upon the fire. In this furnace, air is forced in principally under the grates, and to a lesser extent above the fire.

The bursted tube was four inches in diameter, and of No. 6 B. W. G., or .203 of an inch in thickness, and was the fourth from the left side of the double furnace, rupturing on its under

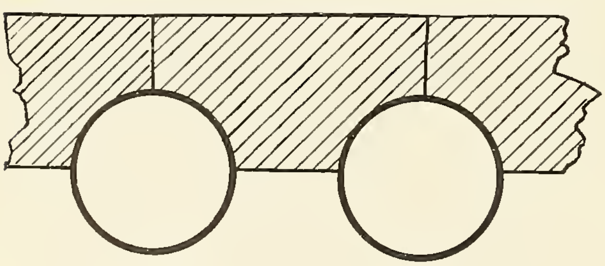
side, directly exposed to the flames, and as though a globule or bulge of soft hot metal had formed and finally ruptured lengthwise the tube, making an open-mouth-cut opening eight inches long and five inches wide—the edges of which were drawn out almost to a knife edge. Two adjacent tubes, one on each side, were found to be bulged in the same place, and will have to be replaced.

Although there are over 400 of these boilers in about forty vessels of the Navy, this is the first accident of the kind on record. Trouble from pitting of boiler tubes has been experienced, and tubes have had to be replaced on that account,



but these tubes were only slightly scarred from this source, and it was, if at all, only a very remote cause of the accident.

Since distilled water is used for feed, the question of scale is quite eliminated from the discussion. The injured tubes were found to be free of scale and dirt, and with very few slight pits. The condition of all of the tubes in the boiler was found to be good, and in practically the same condition as in the detailed and thorough inspection of a few weeks previous. When cut, the metal of the tubes was found very tough and free from granulation. The vessel was constructed in 1904, at a cost of $4,927,122, and the tubes in question were the original ones in the boiler, having been in actual use 3500 hours.

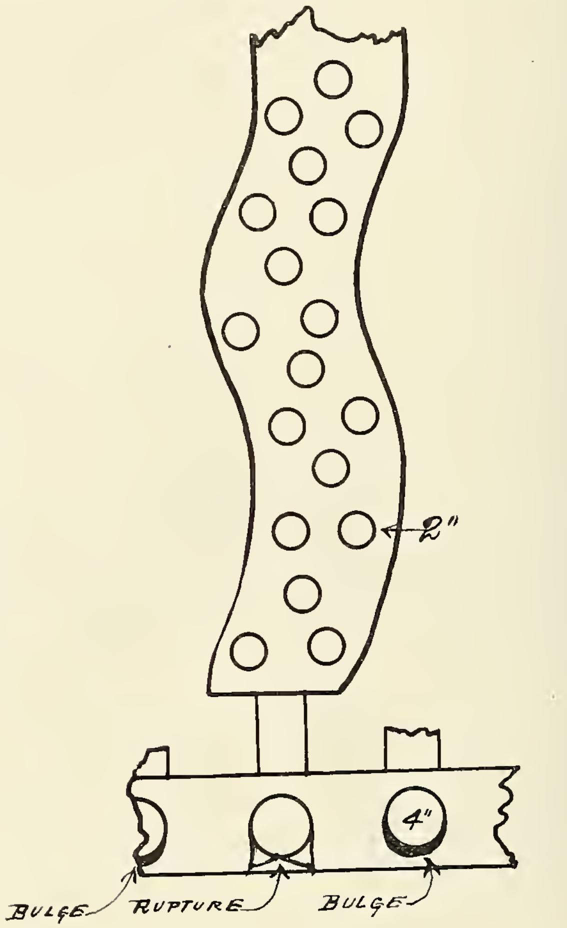


TILE DIVERTING ARCH OVER LAYER OF 4" TUBES.

With the above facts at hand, we may speculate as to the cause of the disaster, with little hope, however, of reaching a definite conclusion or learning much of import. The rupture shows decided signs of overheating, and yet how could this take place? It has been suggested that in the excessive draft of steam from the boiler, large globules of steam formed in the tubes, expelling the water from both ends of the tubes, thus impairing the circulation and causing overheating.

The design of the boiler is such as to avoid such a happening, as the larger tubes are placed in the remote parts of the circulation path, so that the flow will be the same as in the two-inch tubes above. In the microscopic and chemical examination of the tubes, the real cause of the rupture may finally be determined.

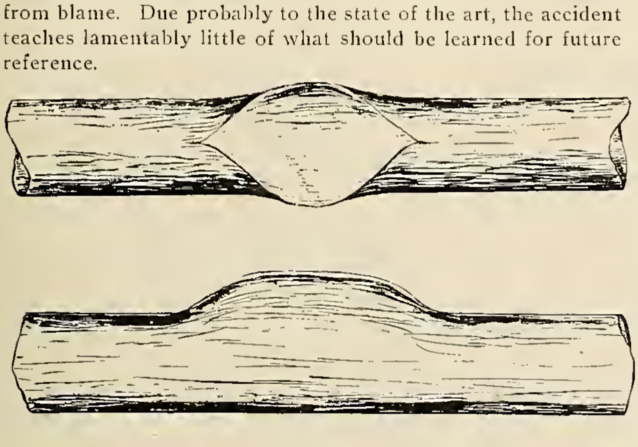
The probability of a local fault in the bursted tube is eliminated by the fact of the bulging of neighboring tubes, one on each side, and practically in line, unless they too were faulty in material. It seems that it would be quite impossible, in the ordinary course of manufacture, to get three tubes together with local faults in each, or of faulty material. In such an instance as this, therefore, one should look for a local condition which caused the fault which was applied to these three tubes, otherwise all of the tubes, or a large part of them, in this and in other similar boilers of the Navy would be found ere this, to develop a similar trouble.



SECTION AT RUPTURE SHOWING ONE TUBE ELEMENT AND MUD DRUM.

An instance of a badly blistered boiler, due to too much grease being baked onto the surfaces of tubes and headers, has been cited by the Navy. This, however, is quite a remote trouble from the one causing the present explosion, for reasons already explained. It is especially unfortunate, that next to the ammunition, the boiler undoubtedly is the most dangerous part of a war vessel, especially at the high pressures necessary, and at the same time it is the most difficult of inspection, particularly on the inside of the tubes, where trouble is liable to develop unawares.

Whatever may be the cause, it is a satisfaction to know that it is due to no one person nor group of persons, and in all probability the manufacturers and contractors are exempt from blame. Due probably to the state of the art, the accident teaches lamentably little of what should be learned for future reference.



Showing the Bulge and Rupture.

The formula $T = \frac{Pdf}{2t}$ for lap welded tubes gives $\frac{265 \text{x} 4 \text{x} 5}{2 \text{x} .203} =$ 13,000 pounds, with a factor of safety of 5, which is conservative for iron tubes, while the bursted tube was of drawn steel and seamless.

ELECTRIFYING GERMAN RAILROADS.

Projected Plans for Change in Motive Power of Several Lines.

Consul Talbot J. Albert sends the report from Brunswick that a beginning with electrifying of some of the railroads in Prussia will soon be undertaken, the preliminary plans being as follows:

The railroad ministry will permit the first great attempts to be made with electrical power in connection with the centrals now existing in the administrative district of Magdeburg. In the first place the short sections, Gusten-Stassfurt and Gusten-Bernburg-Kothen, will be arranged for electrical operation. Later, in further execution of plans, there will be a change of power on the line Magdeburg-Bitterfeld-Leipzig, and afterwards on the line Halle-Leipzig. Upon these, in themselves complete lines of road, electrical power will wholly supplant steam.

The line Leipzig-Halle has been chosen for a special reason. By the electrical operation between these two points there will be a greater increase in the speed and frequency of the trains dispatched, so that in this way Leipzig will be brought into closer connection with the western main lines.

The most favorable factor for the economical determination of the question are the bituminous deposits (Braunkohlen) between Halle and Leipzig. This kind of coal is not considered a suitable fuel for locomotives. One electrical central will suffice for the operation of both lines, and this will be built in the midst of the coal strata. Some years ago the favorable location of these strata suggested the electrifying of the railroad between Köln and Trier, but this was abandoned.

It is said the passenger traffic will be handled in the same manner as upon the road Berlin-Lichterfelde-Ost, namely, with small trains and quick service. The express and freight trains will be dispatched with electrical locomotives. The length of the two lines together amounts to 102½ miles, the line Leipzig-Magdeburg being about 80 miles, and the line Leipzig-Halle 22½ miles. For the current, which will be conducted on thin wires, 10,000 volts will be required. It is calculated that the change in the system of operation will take two years.

LIGHTNING ARRESTERS AND DESCRIPTION OF A NEW FORM OF CIRCUIT BREAKER.*

By A. J. Bowie.

The installation of apparatus for protection from lightning is an insurance not only against danger of damage but also of the continuity of service. The methods of obtaining these results are in some directions diametrically opposed to each other, and the proper design of an arrester is somewhat of a compromise measure. As one writer stated, the designer of arresters is between the devil and the deep sea.

To function properly, a lightning arrester should discharge freely all excessive potential. It should not allow the dynamic current to follow the discharge and, further, in discharging, it should produce no electrical strains on the system, due to oscillation, and so forth. In order to have a free discharge, the series resistance should be largely eliminated, but this is a condition which tends to allow excessive dynamic current to follow the discharge. Hence, to afford the greatest protection, series resistance should be cut out, and to insure continuity of service, a considerable series resistance should be used.

According to Steinmetz, lightning consists of abnormal conditions of potential or frequency, and may arise from either internal or external sources. It is fully as important to protect apparatus from internal strains due to switching, etc., as from strains due to external lightning. The principal arresters at present in use are the Multigap Arrester, the Horn Type Arrester and the Electrolytic Arrester. These arresters all employ one, or a series of air gaps to determine the breaking down point. Resistances are used to shunt or limit the ensuing current.

At the very high frequencies common in lightning discharges, the inductance of lines offers a great resistance to the flow of electricity and tends to localize excessive potential. Thus, it is not uncommon in case of severe strokes to find insulators not far distant from protective apparatus which have either flashed over or punctured. For instance, Mershon states that on the Niagara, Lockport & Ontario Power Company's line, although the line was protected every 2200 feet by rods set for a six-inch discharge gap in the form of a horn gap, lightning punctured an insulator in preference to traveling the distance of 550 feet and going over a gap. He states further that these horn gaps have been of great value, but that the setting was too large and would be reduced.

In considering the production of high voltages by resonance, it is not necessary for a line to resonate as a whole, but sectional resonance may take place which may give rise, in case of high frequencies, to excessive pressure. Thus, a combination of capacity and inductance may, under high frequency, set up excessive strains, while at ordinary frequencies it would have little effect in causing a rise of voltage. When an excessively high pressure is suddenly applied to a line, unless afforded instant relief, it would tend to distribute itself over the system. As the passage of electricity requires time, the result will be an excessive localizing of potential. If a transformer or choke coil is near by, the potential will tend to communicate itself to the apparatus. At the instant when it enters the coil, the full potential will exist across the first turn, and a very brief period afterwards will be distributed across the first two turns and so on, until it spreads over the whole coil. Thus, the first turn must stand the most severe shock from excessive voltage. This condition has led to the use of choke coils and of extra insulation on the end turns of transformers. There has been a great deal of discussion on the advisability of choke coils, and whether it is not better to put sufficient insulation on the end transformer turns. The general concensus of opinion is decidedly in favor of the choke coil. There is a wide difference of opinion, however, on the proper design of choke coils. Some advocate highly inductive coils immersed in oil, and others advise the use of air

*Paper read May 29, 1908, at meeting of San Francisco Section, American Institute of Electrical Engineers.

insulated coils with comparatively few turns. A choke coil is effective only for very high frequencies, and is of little use in keeping out low frequency disturbances. If the inductance is too high, it interferes with the line regulation. As Steinmetz pointed out, a highly inductive coil immersed in oil, which has a high specific inductive capacity, may, under some conditions, make the coil ineffective, and allow free passage for the disturbing potential. If the disturbances originate on the transformer side of the coil, the high inductance of the coil is absolutely detrimental and prevents the arrester affording relief. In view of these conflicting functions, an air insulated choke coil of moderate inductance and also extra end insulation on the transformers seem advisable.

Experience indicates that without doubt the presence of grounded cables running over transmission lines is of material assistance in diminishing the disturbances due to lightning, and that this cable construction is far superior to the mere presence of lightning rods on the towers or poles. The cables should, however, be grounded at frequent intervals. The location of lightning arresters at the ends of long transmission lines, while affording protection to the apparatus at the ends of the lines, does not furnish adequate protection to the line, and intermediate arresters should be installed. The advisable distance apart of these arresters will depend largely on local conditions.

In many types of arresters fuses are used in part of the apparatus. In some cases the fuse shunts an additional air gap which, on the blowing of the fuse, is thrown in series with the arrester and requires a higher break down voltage. This affects the discharge point only, and does not put the arrester out of commission. In other types the fuse cuts out entirely part or whole of the apparatus. In the latter event, the use of fuses is very inadvisable, since the blowing of the fuse takes away protection from the line until the fuse is replaced. It has also been proposed to have several fuses in parallel, each of which is in series with a slightly different gap, the idea being that only one at a time would blow. This is also open to the objections just mentioned. It would appear preferable to design arresters without such apparatus, which may go out any minute and remain indefinitely in this condition until it chanced to be observed by the operator.

Most of the arresters at present in use are of the Multi-gap type, consisting of various combinations of resistances and air gaps. The latter are usually made by setting knurled cylinders of non-arcing metal 1/32 of an inch apart. According to J. C. Wirt, with the best non-arcing alloy, about ten per cent less gaps may be used than are allowable with brass. These cylinders tend to prevent the arc from changing its direction, and in reality the non-arcing property is a rectifying tendency. The characteristics of the gap have been made the subject of extensive investigation by engineers. There have been several papers on this subject in the proceedings of the Institute by Thomas, Rushmore and Dubois, and Creighton. It will require approximately 1500 volts per gap to cause a breakdown of the gap. If the consequent current is not too great, the arrester will extinguish the arc within the half cycle in which it started. Should the current, however, be of too great value, the arc will not break, and the cylinders will fuse together and the arrester burn up. It is evident that with heavy currents the actual time in which the arrester must extinguish the current is exceedingly brief, and the heat being locally applied will soon fuse the cylinders if the current be not shut off. There is a definite amount of energy which can be expended in the half cycle without putting the arrester out of commission. The relation of volts across the arc to amperes depends on the duration of the arc and on whether the current is increasing or decreasing. Thus, for example, according to Creighton, where the current is six amperes, the time of application 1/120 of a second, the voltage across the arc is 56. While if the current has been on several minutes with the amperes increasing, the voltage will be 23, and if the current is decreasing, 20. Similarly with 16 amperes flowing, the voltages are 23, 19 and 18, respectively.

According to Thomas, the number of gaps necessary to suppress the current in a Multi-gap arrester operating at about 25,000 volts varies directly with about the square of the current for a given inductance, and increases rapidly with increase of inductance of the circuit. Hence, an arrester which might work well on a circuit of limited capacity, owing to the limited current, may burn up if used on a system of great capacity. The main elements of one type of arrester, representing the latest development in Multi-gap arresters, consist of various combinations of series of gaps shunted by different resistances, as is shown in Fig. I, H., M. and L. are respectively of high, medium and low resistance. An excessive potential of low frequency will discharge through the high resistance and the gaps in series with it, H. limiting the current to a value which the gaps can suppress. Should the high pressure be due to a wave of excessive frequency, the resistance of H. would be increased, due to the skin effect.

The potential across the series of equal gaps will be equally divided between the gaps when the pressure is constant. However, as Steinmetz has shown, the potential gradient diverges greatly from a straight line when the frequency is very high, owing to the fact that each cylinder of the arrester has a capacity not only to adjacent cylinders but also to ground, resulting in a very unequal potential gradient and in the concentration of potential across the gaps nearest to line. Hence, when the voltage becomes sufficiently high, the gap next to the line will break down, and so on down the line, and if the drop across the gaps which have broken down is sufficient to relieve the voltage so that the steepest part of the potential gradient is below the breakdown point of the gap beyond the last one which broke down, the arrester will not complete the discharge. This is shown in Figs. 2 and 3 diagrammatically. Fig. 2 represents the series of gaps of a Multi-gap arrester showing the capacity between adjacent cylinders and between each cylinder and ground. In the curves below the figure, the straight line represents the potential gradient across the cylinders in event of the steadily applied potential. And the curve represents the potential distribution under the conditions of high frequency current, showing a steep gradient near the line and a reduced gradient near the ground. In Fig. 3 is shown diagrammatically the cause of the partial discharge of the lightning arrester, the main curved line showing the potential gradient due to the impressed voltage. The inclined line shows the voltage drop across the gaps which have discharged, and the curved line in series with this represents the potential gradient of the balance of the arrester after the partial discharge. If the gradient at the upper end of this curve is less than the break down potential of the cylinders, a partial discharge will ensue as shown. Obviously, the point of breakdown is directly dependent on the frequency, and a high frequency will go across many times the number of gaps which a low frequency will disrupt. This is a very important matter in the design and operation of Multi-gap arresters. In order to furnish protection, a lightning arrester must be independent of the line frequency, and one aim of the Multi-gap arrester is to accomplish this result. It has been shown that with an infinite number of gaps there is still a definite limit of potential for a Multi-gap arrester, but this limit is beyond present practice. On account of the potential gradient, it is apparent that in a system with ungrounded neutral and with multiplex connection, if one leg becomes grounded, there is a great likelihood of discharge between lines.

A very high frequency discharge in a Multi-gap arrester will pass direct to ground through the gaps in series. It is a part of the function of the various resistances to draw current from the gaps which they shunt, and so to permit the current through the gaps to extinguish itself. According to Neall, the Multi-gap arrester without series resistance cannot operate satisfactorily, and is liable to burn up. The insertion of series resistance will cut down the efficiency of the arrester as a protective device. In the Multi-gap arrester it is evident that against low pressure surges the arrester action is limited by the high resistance. If the voltage should, however, be very much too high, the intermediate resistance and the gaps between it and the high resistance will shunt the latter. However, this limitation to free discharge is objectionable in an arrester.

in the open will discharge at 40 K. V. when between cement barriers.

The action of the Horn arrester is based on entirely different principles. The Horn arrester is constructed by two diverging metal horns, which either have a uniform divergence in a vertical plane or have a divergence increasing as they ascend, the horns being curved.

In the simplest form the arrester is built with one side connected to line and the other side to ground. This form of arrester is objectionable in general since when the arrester breaks down, the line in question has a dead ground thrown on it at the instant, and if the system is grounded on another phase, or at the neutral, a short circuit will occur. This form of arrester is allowable only as an extreme emergency proposition. Another form of arrester consists of adding a series

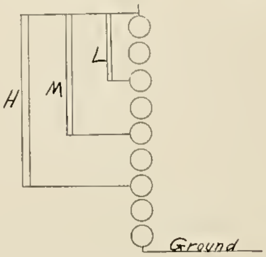
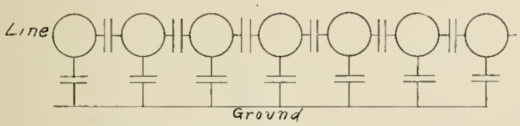


Fig 1



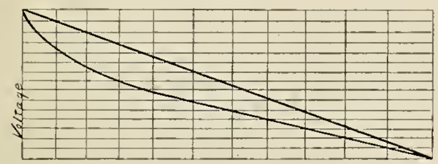


Fig 2

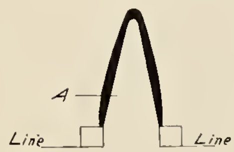


Fig 6

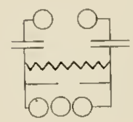


Fig 4

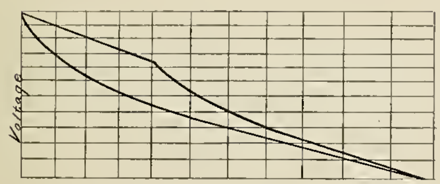


Fig 3

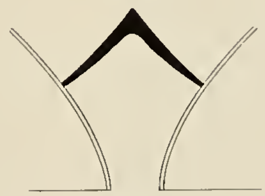


Fig 7

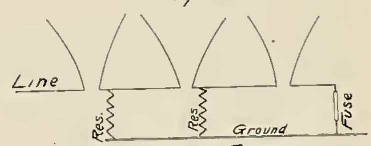


Fig 5

In testing arresters it is a common practice to subject them to a disruptive test, to find the equivalent spark gap for suddenly applied pressure. The needle gap is used in parallel wih the apparatus to be tested. A method employed by Professor Creighton consists of charging by a static machine two ball terminals shown in Fig. 4, each of which is connected to a condenser, the latter being joined in cascade by a high resistance shunted by needle gap in parallel with the apparatus to be tested. The balls are charged until the pressure is sufficient to break down the gap between them, when the full pressure on the balls is instantaneously developed at the needle gap and discharges through it, or through the resistance, or both ways. An interesting point brought out by Creighton is that multi-gap arresters will, under disruptive test, have a maximum equivalent needle gap for a certain pressure. But should that pressure be exceeded the needle gap will decrease at once to perhaps 60 per cent of its previous value. Hence, the most dangerous pressure obtainable with an arrester is just when it starts to spark. The needle gap does not always discharge at the same pressure in the disruptive tests. Thus, with one setting of the balls, the needle gap which always discharged at 3.2", sometimes discharged at 4.3".

The discharge point of the multi-gap arrester may be varied in several ways. Violet rays decrease greatly the point of break down. Oscillation set up by wireless telegraphy may also affect the sparking distance. The setting of the arrester with reference to grounded objects has also an important influence on this subject. According to Mr. R. P. Jackson, a multi-gap arrester which discharges at 75 K. V.

resistance inserted in the path to ground. This will limit the discharge current, but is also objectionable because it prevents free discharge.

Other horn arresters have been built which combine both principles outlined, having a pair of horns at the first gap in series with the resistance to ground, and in shunt to this resistance is another pair of horns, the further side of which is grounded. By setting the second gap slightly larger than the first there is additional assurance against its breaking down. The instant the first gap breaks down the opposing horn becomes practically of line potential. Should the resistance be insufficient to relieve the charge the second gap will break down. Other and better arrangements have been used employing three gaps with respectively high resistance, low resistance, and no resistance in series to ground.

This gives an arrester, where the dynamic discharge current will be minimized. In event of a direct stroke of lightning the gap to ground will relieve the tension.

Among other apparatus of this nature may be mentioned the arresters of Mershon, designed for the Niagara, Lockport & Ontario Power Company. Each element of this arrester was mounted on separate poles. One pole carried the high resistance gap for one phase. A second pole carried the medium resistance gap set for a higher voltage, while a third pole carried the gap to ground in series with a fuse. All arresters were set in parallel. Mershon states that his experience with multi-gap arresters has been bad, owing to the

potential distribution over the gaps. He prefers Horn arresters, which are not so easily burned up, and are not subject to the uncertainties to which a series of gaps are liable. He especially favors Horn arresters, since they may be put out of doors, while multi-gap arresters are unsuited for such location.

Mr. J. C. Smith, in a paper read before the A. I. E. E. gives experiences with Horn arresters on the lines of the Shawinigan Water and Power Co. The station capacity was 11,000 kilowatts, and the transmission voltage 50 K. V., with grounded neutral. Multi-gap arresters were found to be insufficient to protect against severe storms, though they proved satisfactory for switching. Horn arresters were then tried. The first arresters consisted of one horn gap for each phase, with fuse in series, and no resistance. They were set with a 6¼-inch gap. In a later type of arrester two sets of horns were used for each line. The first set was shunted by a 10,000-Ohm. resistance, and the second set went to ground through a fuse. The gaps were 3¾-inches each, and were in series. The arresters frequently discharged over both gaps. By decreasing the first and increasing the second gap and by decreasing the resistance the discharges were practically all forced over the resistance. Since these arresters have been used there have been no interruptions of service.

In the transmission system from Taylor Falls to Minneapolis, a distance of forty miles, multi-gap, Horn type and electrolytic arresters were installed to determine the advantages of each. Since so many different types were put in it is difficult to arrive at conclusions as to just which arresters performed the work of effective protection. The Horn arresters were of three kinds. One composed of a single gap with resistance, a second arrester composed of two gaps in series with resistance from each to ground, the second gap being shunted also by a fuse, and the third type consisted of three gaps in series with resistances for the first two and a fuse for the last. (See Fig. 5.) According to the test papers the Horn arresters took the brunt of the discharge, and Mr. Vaughan states that they may have saved the power house arresters. Their operation, especially at the power house, was very promising, and it is believed that the two and three-gap Horn arresters will be effective in handling dynamic and static disturbances too great for the station arresters to dissipate, and that this can be done with settings which will not interrupt the line. Mr. Neall says, in regard to the same, that it is a grave question whether standard station arresters could take anything like a direct near-by stroke, and that there is less doubt that the Horn arrester could do so.

Quite recently aluminum cell arresters have come into use. These arresters are used in connection with the Horn gap, the break down potential being determined by the gap. They offer a very high resistance up to the critical voltage, but after the voltage has passed this limit they break down and offer low resistance, sealing up again when the voltage decreases below the critical value. They consist of a series of aluminum plates or trays in an electrolyte. The hydroxide of aluminum film which forms on the surfaces of the plates offers the resistance to break down of the arrester. Each element requires from 380 to 400 volts to break it down. It is claimed that the resistance below the critical voltage is 10,000 times as much as above.

As has been mentioned, it is highly important that lightning arresters in discharging should not set up oscillations of any magnitude in the system and give rise to conditions worse than those which caused them to operate.

It is a well known fact that a self-rupturing arc will become oscillatory provided the supply voltage is capable of starting it again across the gap, but in order to become oscillatory, the voltage must be capable of again starting the arc. Where this is not the case the only possible effect of breaking the current under load is to cause the stored energy of the circuit to flow into the capacity of the line and cause a consequent rise of voltage. A study of the interruption of arcs by air and by oil is of especial importance in connection with lightning arresters. It is not uncommon in engineering practice for a theory to obtain credence even though based on most insufficient data. Thus, we find the fallacious belief that oil switches operate without rise of voltage, while destructive oscillations must accompany the operation of air switches. Nothing can be further from the truth. As a matter of fact, there is no switch in existence which can open or close a circuit without danger of causing some rise in potential. With an air switch of proper design the rise will be less than with an oil switch. While a poorly designed air switch may give rise to conditions worse than those which obtain in an oil switch.

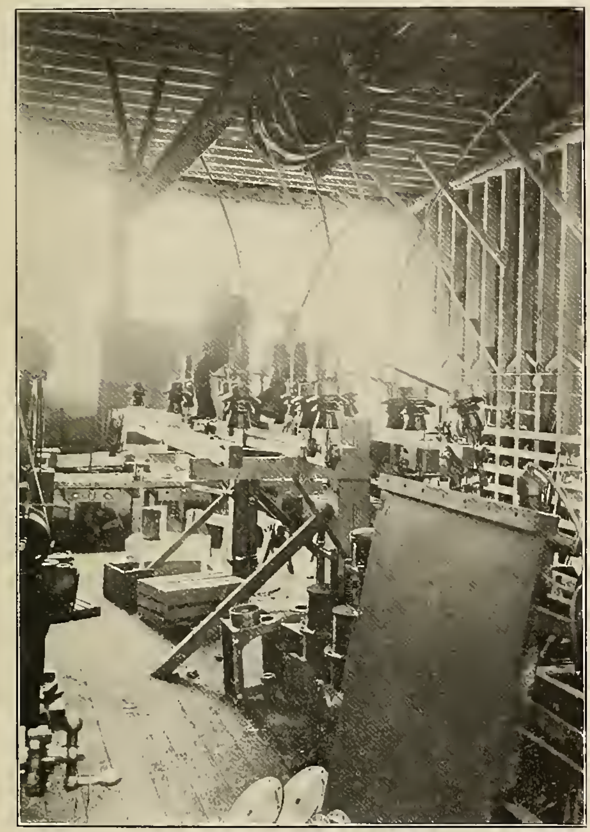
Consider the action of the arc in the interruption of the circuit, occurring in an oil switch. The arc at break is so short as to be of practically no resistance for lines of high pressure. The arc consists of gaseous material upon which the oil presses from all sides. The pressure is such as to cause an inflow of oil and to drown the arc. Owing to the inertia of the oil, it is impossible for it to flow into the arc instantly, and to cut it off at the convenient moment of 0 current, as is frequently stated. Should the arc be cut off when the current is 0, it is merely a coincidence. In a 60-cycle system, the time elapsing between the maximum and zero value of the current is $\frac{1}{240}$ of a second. If the arc be extinguished when the current is only ten per cent of its maximum value, the time between this and the 0 value will be about $\frac{1}{4000}$ of a second which shows the impossibility of such immediate action on the part of the oil. A body falling under the influence of gravity will move $\frac{1}{83000}$ of an inch in $\frac{1}{4000}$ of a second and in $\frac{1}{240}$ of a second will move $\frac{1}{300}$ of an inch.

An air switch of improper design may give rise to oscillations, as is apparent by the consideration of Fig. 6. The break in the switch, as shown, is assumed to be entirely insufficient for opening the load, and the switch is not provided with horns. The arc will go up nearly vertically from the two clips, and the only thing which can break the arc will be the upward pull of the heated gases. Should the arc rupture at the point A, the ascending gases below A may cause it to re-form and set up an oscillation in the circuit. In the case of an air break switch of proper design, such as a horn break switch where the horns are properly curved with due regard to the voltage and load, conditions are entirely different. The arc is carried upward not only by the heat of the gases, but also by the magnetic effect of the current in the horns which is greatly intensified by the use of iron horns. The arc will take the form as shown in Fig. 7, and, owing to its length and approximately horizontal direction, it will introduce a high resistance into the circuit which will materially cut down the current before rupture. When the arc breaks, it will rupture near the horns where it will be impossible for the ascending vapors to cause it to re-form. The current will break when near zero, but as in the case of the oil switch, it can not be depended upon to break at zero. However, owing to the greatly diminished inertia of the air, it will, on an average, break nearer zero than when breaking under oil. The current being weakened by resistance will prevent the rise in voltage which occurs with an oil switch.

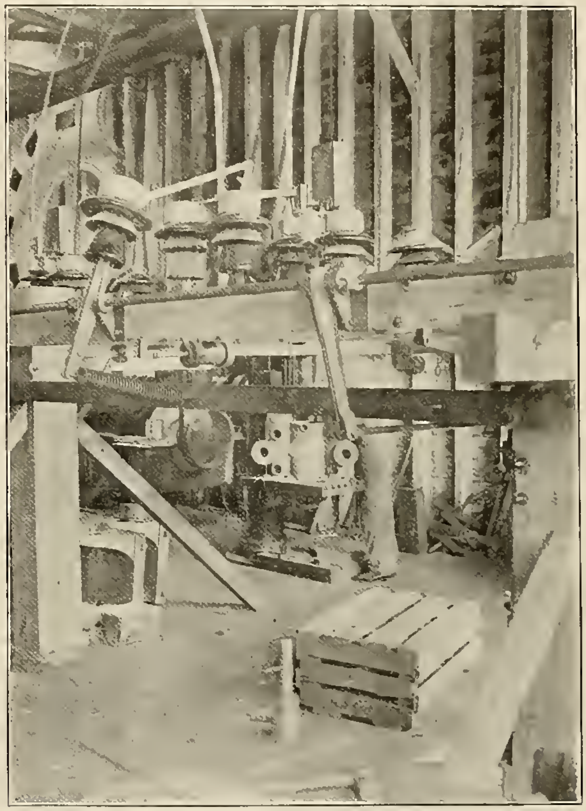
The statement that air break switches of proper design do not cause a serious rise in voltage is not merely a matter of theory, but is amply demonstrated by the results of practical experience, not only of myself but also of experimenters and engineers who follow this subject closely.

The numerous experiments conducted by Mr. P. H. Thomas, of the Westinghouse Electric Co., fully bear out my statements, as is shown by the following quotations from his papers read before the A. I. E. E.:

In the paper of June 19, 1905, Mr. Thomas gives the following results obtained in the operation of high pressure oil switches on an unloaded line of the Telluride Power Co., between Provo and Logan. The oil switches were at the power house. In one test when the high tension switch was closed, the voltage between transformers which had been 38 K. V. jumped to 70 K. V. On opening this switch, the pressure again jumped to 55 K. V. In another test, the voltage between lines which was normally 36 K. V. jumped to 57 K. V. on closing the high tension switch and to 63 K. V. on opening it. This is nearly double potential from opening the line under only the charging current. All voltages were recorded by the spark gap.



GENERAL VIEW BOWIE CIRCUIT BREAKER.



DETAIL SHOWING SPRING DASH-POT AND OPERATING LEVER FOR CLOSING BREAKER.

With reference to the rise of the voltage from arcs in air Thomas states (Page 363, Vol. XXIV, Transactions A. I. E. E.): "It has been difficult for me to conceive of a series of rapid self-interruptions of a severe arc associated with an extreme rise of potential at point of interruption. The extremely rapid heating and cooling of the gas which is taken to have a more or less steady condition of interruption, together with the fact that such a large majority of severe arcs occur without noticeable rise of potential, makes it seem probable that in those cases in which a rise is actually observed, there is some other condition in addition to the presence of the arc which is really the essential condition causing the extraordinary voltage. In a number of cases within my knowledge prearranged for the opening of short circuit, apparatus for measuring instantaneous voltage has shown no sensible rise of potential."

Referring to this same subject, Mr. Thomas in a later paper before the Institute (Pages 918-924, June, 1907), states: "When, however, in the case of the opening of such a short circuit as in an open air arc, the extension of the length of the arc proper has reduced the current to a value where it becomes relatively unstable, there will be a tendency for the arc to go out suddenly, causing the remnant of the energy originally stored in the inductance to produce a rising potential. This residue will, however, never be more than a small portion of the maximum energy stored. A great many direct tests of the opening of circuits through enclosed fuses and circuit breakers where conditions have been definitely known to be as assumed, have shown practically negligible rises of potential. The fact that high voltages have appeared in electric accidents and arcs is not proof that these high voltages have resulted from the sudden interruption of heavy short circuits.

"The definite data available at the present time have as far as I am aware failed to indicate any serious rise of potential from the operation of fuses, horn or magnetic blow-out arresters."

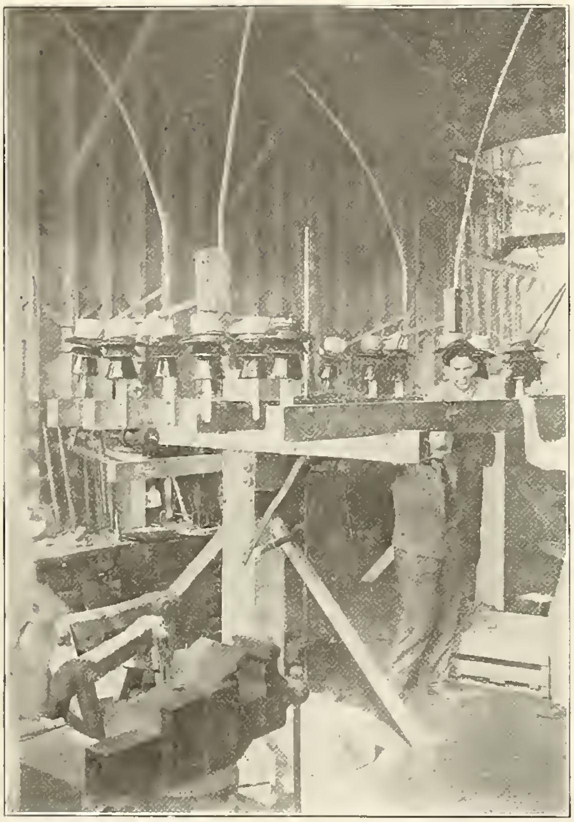
The rise of pressure from sudden interruption of circuits decreases in its relative effect very greatly with increased line pressures. Thus, under the worst possible conditions assuming that the maximum full load current of a 20 000 kilowatt, 125,000 volts, three-phase line is instantaneously interrupted, the total rise in voltage would be only approximately 50,000 volts, and consequently the actual rise obtained when opening a suitable type of horn break switch, would be entirely negligible. The rise of potential as given above, you will note is independent of length of line, the energy stored in the line inductance and the capacity of the line both increasing directly with the length. The stored energy is assumed to charge the line to higher pressure as its only means of relief, and this is assuming the worst possible conditions.

According to Mr. Neall, Dr. Gustave Benischke, of Germany, in tests which he made, and in tests he quoted by Slaby, states that multi-gap arresters may give rise to conditions worse than those which caused them to operate, while the Horn arrester does not do so.

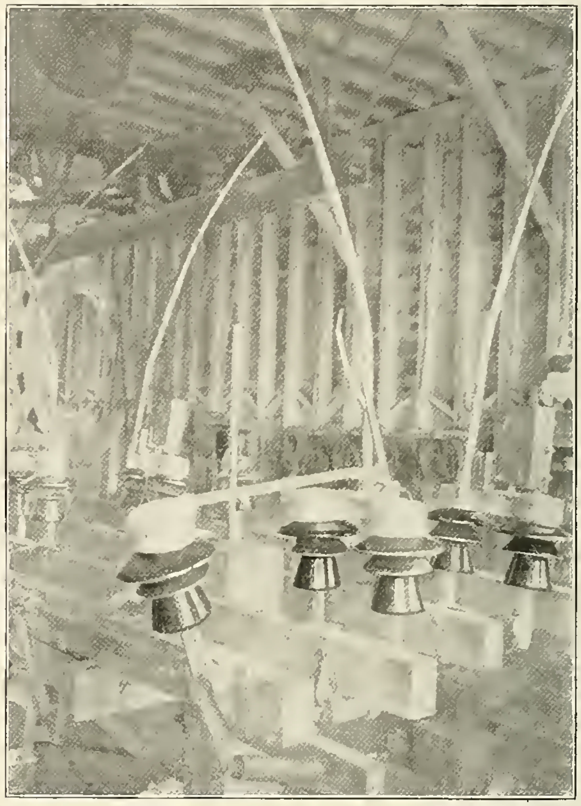
A curious phenomenon in connection with lightning arresters occurred some years ago at Sacramento. The resistance of one of the lightning arresters had burned up, and Mr. Hutton, in its place, inserted temporarily a piece of No. 18 bare copper wire. When this was taken out some days later it was observed to be marked at regular intervals with dark spots about a half-inch long on alternate sides of the wire, the distance between adjacent spots on the same side of the wire being about three inches. I have never been able to explain satisfactorily this discoloration. If it depended on the wave length of some discharge from the line, the distance of three inches would have indicated a frequency of four billion cycles per second, under the assumption of the speed of 186,000 miles per second for the movement of electricity.

The location of high tension apparatus is an important consideration. There is a growing feeling among engineers about putting at least part of this apparatus out of doors and reducing not only the possible hazard, but also the expense for housing. Where ample room is allowed for very high tension work, the necessary clearance of wires takes up a surprisingly large amount of space. If such clearance be not allowed the danger of accident is increased. To quote from Mershon, "In my opinion, a very desirable requirement of lightning arresters is that they should be installed out of doors. I believe as time goes on more and more high tension apparatus will be installed out of doors, instead of in a building. I think the time will come when not only lightning arresters but also bus-bars, transformers and even automatic circuit breakers will be regularly installed out of doors. It seems rather illogical, and from some standpoints, almost ridiculous, to install high tension bus-bars in a building with barriers and all sorts of other complications, when the lines leading off the bus-bars go immediately out of doors unprotected and often installed on very questionable line structures."

For some time past I myself have felt that it is highly desirable, that much of the high tension apparatus should be preferably located out of doors, not only to minimize the danger of accidents, but also for reasons of economy. It seems hardly the part of good judgment to enclose in a building apparatus with a strong potential hazard not only to itself but also to the balance of the equipment. I have been working along these lines for sometime past, and I am pleased to call to your attention a high tension circuit breaker which I have developed and put into practice. It embodies some features which, as far as I am aware, are new to engineering practice. The circuit breaker is for out-door use, and no series transformers are employed, the line being taken directly through the trip coil, which is housed in a brass box, mounted directly on line insulators. In the Form D Circuit Breaker, all poles are simultaneously closed by a single lever, and the opening of the poles either automatically or manually is simultaneously accomplished. I have here one of the latest developments of this type of circuit breaker with an inverse time element. The stronger the over-load the less the time of release of the trigger. The magnet is very powerful, and insures positive action. The releasing latch is enclosed and is protected from burning or from the effects of the weather, the box being sealed by a rubber gasket. The first action is to depress the bellows used as a retarding element. After this has been compressed to a predetermined point it is unlatched from the armature, which is then free to rise rapidly and to strike a hammer blow to the release latch, which ensures its opening.



VIEW SHOWING OPERATING HANDLE FOR CLOSING BOWIE CIRCUIT BREAKER.



CIRCUIT BREAKER OPEN.

THE ATTITUDE OF THE LAW TOWARD ELECTRICITY.

By Emerson W. Read.*

Corporations engaged in the manufacture and distribution of electricity are given almost the same powers as are given to the ordinary commercial corporations or companies. The dangerous nature of this commodity, however, has caused the law to build up rules and regulations peculiarly applicable to this industry. Generally, such rules are not departures from the general rules of law, but are wholly in keeping with the general principles applicable to corporations, companies, negligence, bailments, and the like. The law of electricity is not, then, a law unto itself, but is the mere application of the general rules of law to a special industry.

Although, seemingly, the law has drawn more stringent rules about this industry than about others, it nevertheless must be recognized that, when compared with rules and regulations governing mining, carriage in elevators, rapid transit, and activities of a like nature, they are fair and equally applied. It alone is not subjected to the most exacting legislation. Its very nature requires exacting rules for the preservation of public safety.

Yet companies engaged in the manufacture and handling of this dangerous commodity are subject only to reasonable regulations and restrictions by the authorities. Such regulation must not be arbitrary. Municipalities cannot require performance of a company which is unreasonable, unnecessary and a hardship. Electric companies (as shown in the Geneva Telephone Case, 62 N. Y. Supp.) may be required to transfer their wires from poles to conduits. Too, they can be required to supply their product for purposes of power or lighting only to premises within a specified distance of their power wires (Moore v. Champlain Electric Co., 88 N. Y. App.).

Generally, electrical companies cannot place their poles in public streets except at points designated by the municipality; and the stringing of wires and erection of poles is continually subject to the police powers of the community. And while the municipal and community interests are always to be regarded, the public-service corporation must also respect the civil rights of property owners. It has been held that a company cannot place a pole in front of property abutting on a street unless it is necessary for the better transaction of its business (Tiffany v. U. S. Illuminating Co., 51 N. Y.). After a long succession of battles in the courts of the various States, it has been definitely determined that the erection of poles in front of private property abutting on a street is such a deprivation of property as makes it a constitutional question. It interferes with a property owner's easement to light, air, draught, etc. Poles may usually be erected, however, upon the consent of the adjacent owners; but even then, no license is given the company to injure or mutilate the trees of such adjacent owner. So far was this principle carried that in Malone v. Waukesha Electric Light Co. (Wisc. 1904), the Court held that in the absence of special authority a company has no right to set a pole in front of an abutting owner's property, so as to require the trimming of his shade trees, without his consent. The main authority in California on this question (Mutual Electric Light Co. v. Ainsworth, 118 Cal.), holds that an ordinance requiring special permission from the Board of Supervisors before poles can be erected on streets is valid.

*B. L., L.L.B., of the San Francisco Bar.

The terms "due care" and "ordinary diligence" as used in the law of negligence are used in a relative sense, and designate a degree of care commensurate with the danger involved. In the control and management of an exceedingly dangerous agency, such as electricity, the law exacts a corresponding degree of care and diligence (24 Oregon 276). To this end circumspection and foresight with regard to reasonably probable contingencies must be used; not merely mechanical skill.

The duty owed by an electrical company to private and public interests, as regards its wiring, varies with the location of wires, current passing thereon, and other such considerations. When the wires are carrying a highly dangerous current, the law imposes upon the company the utmost degree of care in their construction, inspection, and repair, so as to keep them harmless at places where persons are most apt to come in contact with them. So it will be seen that ordinary care is not enough. "Reasonable care" must be used, and in the handling of electricity "reasonable care" means "utmost care." The law exacts the very highest degree of care practicable to avoid injury to everyone who may be lawfully in proximity to the wires (Giraudi v. Electric Imp. Co., 107 Cal.), and likely to come, accidentally or otherwise, in contact therewith.

Recent Decisions.

(I.)

The rule that a railroad track of a steam railroad is a place of danger, and that one intending to cross it must avail himself of every opportunity to look and listen, does not apply to one proceeding along the tracks of a street railroad. The correct rule is, that one riding or walking along the tracks of a street railroad company must use reasonable care in the exercise of his faculties of sight and hearing to watch and listen for cars going in either direction (Hamlin v. Pacific Electric Co.).

However, the rule differs in the various States as to the degree of care one must use about the tracks of a steam railroad.

(II.)

Reeve v. Colusa Gas & Electric Co., a California decision of very recent date, holds: It is not, in the present state of scientific knowledge, a fact so generally known that it has become a matter of general knowledge of which all must take notice, that when electricity is operated in two separate currents or phases, carried on different wires, it is necessary to the economical management of the system and to the proper "balancing" of the currents, that both phases be turned on at the same time, but that they will work separately though not so well, or so economically. . . . There is no established rule of law to the effect that a servant, when directed to work near wires of an electric system controlled by the master, must, at his peril, ascertain whether or not the current has been regularly turned on at the time. In such a case it is the duty of the master to use reasonable care to so control and manage the ordinary operation of the system and the places where the servant is put to work, that the wires shall be free from dangerous currents under the master's control while such work is in progress, or to give the servant warning of the danger and all instructions necessary to enable him to avoid them so far as may be reasonably possible and compatible with the nature of the work. If the master gives the order to work at a particular place and gives no warning of danger, the servant may rightfully assume it to be free from danger from causes under the master's control, and which are not apparent to the servant after such observation as the circumstances reasonably require.

JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President

E. M. SCRIBNER, Vice-Pres. and Gen'l Manager.

A. H. HALLORAN, Secy and Managing Editor

Directors:

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot commence with back numbers.

Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX JUNE 20, 1908 No. 25

CONTENTS.

EDITORIAL.

TENNESSEE BOILER EXPLOSION.

The regrettable accident whereby eight faithful men were killed in the boiler explosion on board the United States armored cruiser "Tennessee" has been detailed elsewhere in this issue by Mr. Clem A. Copeland. It calls to mind a similar accident in the early eighties, on the old "Tennessee," in which one man met his death. It is to be hoped that the lamentable coincidence will not be added to the so-called "hoodoos" to which the superstitious attribute natural phenomena.

Any speculations as to the underlying reasons for this disaster are futile until after a complete examination has been made. But that the results of this inquiry should be given the widest publicity is a duty whose importance cannot be over-estimated. The lives of many are being jeopardized daily during the performance of a work which is just as necessary in warfare as is fine markmanship. The "man behind the gun" is no more important than is the man before the boiler. He should be surrounded with every possible safeguard.

In raising the speed from eighteen to twenty knots preceding the explosion, high pressure steam had been admitted into the intermediate cylinder of the two triple expansion engines, thus withdrawing a great amount of steam from the boilers and causing the pressure to drop from 265 to 235 lbs. It seems probable that this sudden steam draught might be so great, in connection with a limited feed-water supply, as to leave part of the lower tubes empty. Being without water the tube was first burned and then ruptured with the most disastrous results. The inference is that more ample water supply in the lower tubes might have prevented the accident. It is more than likely that the boilers were not originally designed to supply the great quantity of steam necessary for the intermediate cylinders. This method of increasing the speed is possibly the immediate cause of the disaster. These remarks, however, are merely suggestive, and final judgment should be reserved until the complete findings have been published.

LIGHTNING PROTECTION.

Men have tried to arrest the lightning stroke, ever since Franklin "tried to tickle lightning with the tail of a kite," and thereby proved its kinship to electricity. But, notwithstanding the claims of the old-time lightning rod agent, absolute insurance against danger from lightning yet remains to be provided. No arrester thus far produced is capable of always protecting apparatus against a direct stroke. But such are only a small proportion of similar disturbances to which transmission lines are liable. A passing thunder-cloud induces a like electro-static effect, as also does the friction of wind-blown sand, dust or snow on a smaller scale. Sudden changes in

the load or short circuits cause the same trouble. Consequently any phenomena of abnormal voltage and frequency may be classified under the generic name of "lightning."

Certain devices are available to take care of these potential accumulations. They may be said to bear the same relation to absolute protection, as does an accident to a life insurance policy. They are alleviative rather than preventive. For high-tension transmission lines devices for lightning arresters consist essentially of one or more air-gaps in series between the line and the ground. The dynamo current is prevented from following by means of resistances and arc suppressors. Of such a type are the multi-gap, the horn, and the electrolytic. The first consists of several short air-gaps in series, the terminals being made of non-arcing metal. One longer air-gap is used in the horn type, which consists of two diverging metal horns so shaped that the arc length is increased by magnetic action and the rising hot vapors, until it cannot be maintained by the generator voltage.

More recent is the aluminum cell arrester, consisting of a series of aluminum plates in an electrolyte. A film of aluminum hydroxide acts as a valve that opens at a definite pressure and allows the high voltage discharge to pass, but prevents the grounding of the ordinary line voltage.

The characteristics of these arresters are so admirably described in the paper in this issue by Mr. A. J. Bowie that there remains but little to be added. Recent practice has demonstrated certain advantages of the horn type for line protection, and of multi-gap arrester with oil insulated choke-coils supplemented by the aluminum cell type for station protection. But in this connection it must not be overlooked that it is far better to guard against such disturbances than to attempt to discharge them. Grounded overhead and side wires will often take the discharge away from the transmission line and thus protect it.

Critics have commented in regard to the local irrevalence of this discussion by stating that thunder storms are exceedingly rare on the Pacific Coast, and lightning almost unknown along the sea shore. But all our large hydro-electric transmission systems come from the mountains, and there atmospheric electric phenomena are very common. Thunder storms may occur during any part of the year, the records showing as many as 356 during twelve months. In 1896 the plant at Haywards Electric Light Co. was struck by lightning, as was also that of the Folsom Electric Light & Power Company and the station at Ontario. In 1899 the telephone and telegraph poles in the San Joaquin Valley were damaged, and many other instances may be cited where destruction was caused by these forces.

The progressive action of a lightning discharge "acting like a conducting wedge with the ions rushing in behind the wedge to cleave the air ahead" as suggested in our eastern contemporary the "Electrical World," bears a striking analogy to the ancient Norse idea of its nature. In the lightning flash they saw a path cleaved through the air by the hammer "Mjolner," wielded by the mighty arm of Thor. In the light of this recent knowledge it may be but a short time before efficient lightning protection can be devised. In the meantime a poor arrestor is better than none.

PERSONAL.

Irving Philips, recently connected with the North Mountain Power Co., is now installing a hydroelectric plant for C. S. and R. S. Moore, Klamath Falls, Oregon.

Mr. W. J. A. London has recently accepted the position of chief engineer of the Terry Steam Turbine Company, Hartford, Conn., succeeding Mr. C. E. Terry, recently deceased.

F. H. Poss, Pacific Coast Manager The Holophane Company, started on an extensive trip East this week. After visiting St. Louis and Chicago, he will attend the annual Holophane meeting at Lake George, in Canada, proceeding thence to New York.

Mr. W. S. Dix, sales engineer for R. Thomas & Sons Co., of East Liverpool and Lisbon, Ohio, is in San Francisco. Mr. Dix expects to remain on the Pacific Coast for several months, and make a thorough investigation of local transmission conditions.

At a recent meeting of the San Francisco branch of the National Electrical Contractors' Association, the following officers were elected for the ensuing year: President, Robert W. Martland; vice-president, Paul C. Butte; secretary, F. W. Meyers, and treasurer, Chas. E. Wiggins.

David S. Murray, after almost twenty-four years of continuous service in the employ of the Rocky Mountain Bell Telephone Company, will resign his position as general manager in July and become a member of the general executive staff of the Pacific Telephone & Telegraph Company, with headquarters at San Francisco. It is understood that H. Vance Lane, president of the Rocky Mountain Bell Company, will assume the active management.

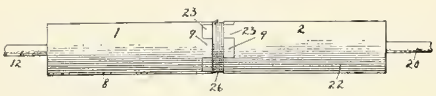
BOOKS RECEIVED.

"Theory, Design and Construction of Induction Coils," by H. Armagnat, translated and edited by O. A. Kenyon, published by McGraw Publishing Co., New York City; price $2.00. After a few introductory definitions and a historical resume, the author discusses the theory of mechanical and electrolytic interrupters, detailing several experimental demonstrations and illustrating his argument by oscillograms. The theoretical treatment is continued by a discussion of the striking and disruptive voltages of secondary currents, and concluded by a chapter on the power and efficiency of induction coils. In his lucid directions for construction, the author successively describes primary, secondary, dielectrics, condensers, and the various interrupters for all types of induction coils. A theoretical discussion of Tesla's transformer is also added. After a chapter on the application of induction coils to the laboratory, medicine, radiology, wireless telegraphy and gas engine ignition, the volume is concluded by a bibliography bringing the subject down to the present date. This excellent translation of Armaguat's treatise "marks a decided advance towards the day when induction coils will be used for all purposes with the same assurance and accuracy as we now calculate transformers."

PATENTS

CONNECTOR FOR ELECTRIC WIRES. 889,786. Charles J. G. Keiner, Baltimore, Md., assignor to Universal Railway Supply Company.

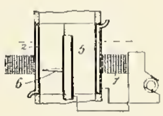
An electric wire connector having a socket-member and



a plug-member; an insulating covering around each of said members and the adjoining ends of said coverings having intermeshing fingers and means for engaging the fingers on the two coverings to hold the members together.

ELECTRIC FURNACE. 889,857. Albert J. Petersson, Alby, Sweden.

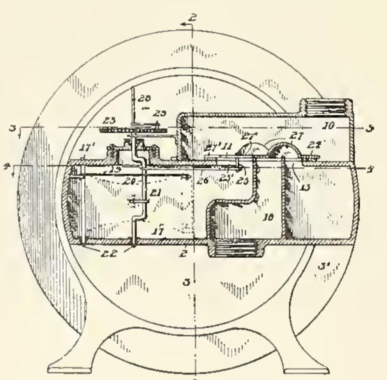
In an electric furnace for treating gases by means of voltaic arcs, the combination of a furnace chamber, an inner central electrode, an outer electrode concentric therewith, an



energizing coil around the said outer electrode, means for connecting the said coil in series to the arc between the said electrodes, the said coil forming an inductive resistance for the arcs, and means for moving gases through the said furnace chamber.

GAS-METER. 889,652. James R. Armstrong, Pittsburg, Pa.

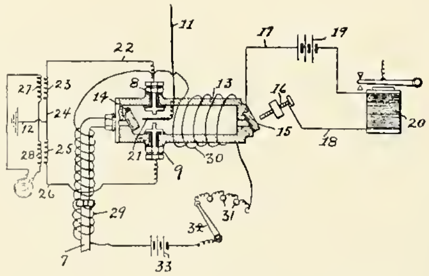
The combination of an inlet chamber, measuring chambers having ports opening into the bottom of the inlet chamber, a diaphragm separating the measuring chambers,



an outlet, a slide valve in the bottom of the inlet chamber for controlling the passage of gas therefrom to the measuring chambers and from the latter to the outlet, and mechanism located within one of the measuring chambers for operatively connecting the diaphragm and valve.

WIRELESS TELEGRAPHY. 889,791. Isidor Kitsee, Philadelphia, Pa.

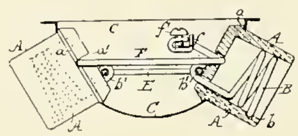
In combination with a receiving device wherein through the expansion of a gaseous medium a localized translating



device is operated, means to enforce the heating effect of the incoming impulses, said means comprising means to generate locally impulses adapted to enforce the impulses transmitted.

MULTIPLE SOCKET FOR ELECTRIC LAMPS. 889,812. Frank J. Russell, New York, N. Y.

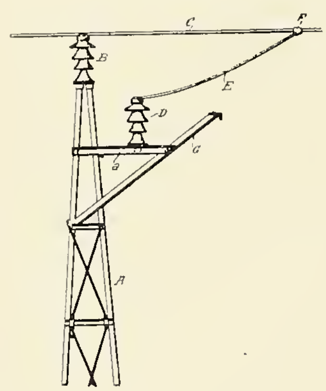
A multiple socket having a canopy, with a plurality of sockets supported in the canopy and two conducting pieces electrically connected one to one set of socket lamp contacts,



and the other to the other set of socket lamp contacts, said two conducting pieces being supported independently of each other by the insulating portions of the sockets, and at the same time serving to hold the sockets in place in the canopy.

SUPPORT FOR ELECTRICAL CONDUCTORS. 889,803. Francis B. H. Paine, Buffalo, N. Y., assignor to Niagara, Lockport & Ontario Power Company.

In a high tension transmission line, two insulators suitably supported, a line wire directly attached to one of said



insulators, a short conductor electrically and mechanically connected to the line wire and attached to the other of said insulators, the two insulators and said conductor being so arranged that the line wire or attached conductor will move when one of the insulating supports fails, and a contact in the line of said movement included in a circuit by contact with the conductor or line wire.

INDUSTRIAL

NEW ADAPTER FOR TUNGSTEN LAMPS.

The Benjamin Electric Mfg. Co., of Chicago, are placing upon the market a new device in the form of an Adjustable Plug Socket, the principal use of which is that of an Adapter for Tungsten Lamps. It is provided with rotating sleeve which permits a complete revolution of the socket, together

Cut 1

Cut 2

with a hinge joint securing almost any angle of adjustment desired. The position of lamps in a fixture or bracket may thus be changed to the vertical. This is shown in Cut 1. Where lamps are desired at right angles, i. e., with a horizontal socket or receptacle, a second device is furnished. This is illustrated in Cut 2.

ALUMINUM LIGHTNING ARRESTERS.

Aluminum electrolytic lightning arresters are manufactured by the General Electric Company, Schenectady, N. Y., for all voltages up to 100,000 volts, and are designed to protect electrical systems from all lightning disturbances, considering lightning in the broadest sense. Bulletin No. 4595 describes the Form I arrester, which is now being placed on the market. A view showing a cross section of the arrester in its durable steel tank is given. The arrester consists of a "stack" of concentric inverted aluminum cones, insulated from each other and placed in a tank of oil. Before being placed in the oil the space between the cones is partially filled with a special electrolyte. The critical value at which the electrolyte breaks down is 420 volts for any two adjacent cones, and when this potential is reached the action is similar to that of a safety valve, and a large amount of current allowed to flow during discharge. This action is produced by a thin film, which forms on the aluminum plates by electrolyte action, and as soon as the discharge ceases the film immediately reforms. Illustrations of lightning arresters for different capacities, diagrams of dimensions and connections, and other data are given in the bulletin, which is of timely interest to the managements of electrical installations.

INDIANAPOLIS BRANCH OF THE H. W. JOHNS-MANVILLE CO.

The H. W. Johns-Manville Co., of New York, announce the opening of a branch office in Indianapolis, Ind., to take care of the local requirements of the trade in that territory. This office, which is located at 30 South Pennsylvania Street, Indianapolis, will be under the management of Mr. Charles E. Wehr, who, for several years, has represented the company in that section.

DUNCAN BUYS LA FAYETTE.

The Duncan Electric Manufacturing Co., of La Fayette, Indiana, have purchased the machinery, tools and business of the La Fayette Electrical Manufacturing Company, manufacturers of transformers. The transformer plant has been thoroughly rejuvenated, and the most modern transformer manufacturing apparatus installed, and every effort will be made to keep the quality of the new transformers up to the highest possible standard. They have secured the services of one of the most competent transformer engineers in the United States, and every transformer made will be sold under guarantee that already appeals to every central station manager. Workmen are now installing an impregnating outfit, and the company will soon be able to offer to transformer users a complete line of this type. A new departure in the testing of transformers is that of subjecting them to a higher breakdown test as an extra means of insuring a high standard of dependability.

EXAMINATION FOR ENGINEER.

The United States Civil Service Commission announces an examination on July 8, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of engineer, Schedule B, in the United States Mint at Denver, Colo., at $4.25 per diem, and vacancies requiring similar qualifications as they may occur in the Mint and Assay Service throughout the United States.

WESTINGHOUSE ACQUIRES HADAWAY.

The offices and works of the Hadaway Electric Heating & Engineering Company, which was some time since acquired by the Westinghouse Electric & Manufacturing Company, have been removed from 238 West Broadway, New York, to the works of the Electric Company at East Pittsburg. This change will permit the business to be carried on upon a much larger scale than formerly, and all the standard appliances for hatters, confectioners, printers and other manufacturers will be turned out in larger quantities. Special attention will be given to the manufacture of the sad irons, glue pots and similar appliances that have recently become so popular. A New York office will be maintained on the 22nd floor of the City Investing Building, 165 Broadway.

NEWS NOTES

TRANSMISSION.

Red Bluff, Cal.—Harry Polsley and George J. Hiller have filed on 1000 inches of the water of the south fork of Cottonwood Creek. The water is to be measured under a six-inch pressure head and is to be used to generate power.

Reno, Nev.—The large flume, furnishing power for the electric plant of the Reno Power, Light & Water Co. caught fire last Wednesday, and before the flames could be extinguished, a large portion of the flume was destroyed. The power plant was seriously threatened.

Seattle, Wash.—The university regents have let the contract for the university power-house and plant. The contract for the construction of the power house was awarded to H. Chase & Co. for $16,557, and the Hallidie Machinery Co. obtained the contract for the installing of the machinery in the building for $72,900.

Pocatello, Ida.—The Lost River Light & Power Co. will construct a 700-foot pipe line from Cedar Creek to a concrete power house near the town of Mackay, which will generate 150 horsepower of electrical energy for the Mackay mines and fifty horse-power for the lighting of the town. A franchise for the latter proposition has been granted.

Corona, Cal.—The Temescal Water Co. has sold to George I. Lamy, of Los Angeles, Lake Elsinore, to drain the lake of its present contents and construct a dam across the eastern end. Mr. Lamy's plan is to build a power plant on the Santa Ana River, thirty-five miles away, where he will develop a 3000 horse-power plant. The contemplated improvements will cost about $300,000, and will include the installing of four giant generators, the electric current to be developed being placed at 3000 kilowatts.

Red Bluff, Cal.—The organization of another electric power company in Tehama County is likely to be consummated in the near future. Valuable water rights on Mill Creek are owned by Gorham King, T. H. Ramsey, S. P. Stice, the E. D. Gardner estate, Smith Crowder, W. A. Fish and W. F. Luning, and negotiations are now under way for their sale to a party of capitalists who expect to spend over a million dollars in the construction of a plant to generate electric energy.

Oakland, Cal.—The Great Western Power Co. has let a contract to the Globe Construction Co. for the erection of a transformer sub-station on a triangular block of land, bounded by White and King Streets and Fourth Avenue in East Oakland. The sub-station which will be built is to be a brick structure of ornamental design, and machinery will be installed for the transforming of the power from the Big Bend plant on the Feather River. A subway, one mile in length, will connect the sub-station with the steam power house at the foot of Fifth Avenue. The transmission lines are now in the course of construction, and between thirty and forty miles has been finished. Stretches have been completed above Oroville, in Sacramento County, and in Contra Costa County. The transmission cables are carried on steel towers thirty feet in height, and it is expected that the first installation will be completed by October 1st.

ILLUMINATION.

Vallejo, Cal.—The Vallejo Gas Company is planning to increase the size of its main on Marin Street from York to Georgia.

Santa Maria, Cal.—The Monterey County Board of Supervisors has granted Messrs. C. P. Baird and W. L. Lierly of Santa Maria a franchise for electric lighting privileges, etc.

Huntington Park, Cal.—The City Council has been discussing a proposition made by A. A. Weber for the erection of a gas plant. It is stated that the request for the plant will be granted.

Pasadena, Cal.—Arrangements have been completed to sell to the First National Bank of Pasadena the $100,000 bond issue voted February 20th for the purpose of extending the municipal lighting system, etc.

Bremerton, Wash.—The City Council has terminated a long fight by granting a franchise to Ezra Norman, giving him the right to construct and operate a gas plant in the city of Bremerton and lay mains for distribution.

Pasadena, Cal.—The City Council has opened the bids of B. F. Kierulff, Jr. & Co., and of the Chicago Insulated Wire & Manufacturing Company for various items for supplies for the municipal light plant, and both bids were accepted.

Los Angeles, Cal.—The Los Angeles Gas & Electric Company has applied to the City Council for a lease on a strip of land in the bed of the river under Aliso Street bridge and adjoining its gas plant. The space will be used for a settling tank to catch objectionable refuse which has formerly been allowed to escape into the river bed.

TRANSPORTATION.

Oxnard, Cal.—T. C. Carnahan has obtained a franchise to run electric cars through A street from the southern to the eastern boundaries of the city, and to connect with the Bakersfield and Ventura Railway, which runs to Hueneme.

San Bernardino, Cal.—The Board of Supervisors has passed an ordinance granting to A. G. Hubbard a franchise for the construction, maintenance and operation of a street railway upon Brookside Avenue, Alder Avenue, Railroad Avenue, and Barstow Avenue.

Portland, Ore.—The Portland Railway, Light and Power Company has applied for a franchise to build and operate electric railway extensions on forty separate streets of the city, embracing many miles of lines and costing hundreds of thousands of dollars. The permit has been granted.

Los Angeles, Cal.—Henry E. Huntington has notified the City Clerk that he has sold to the Los Angeles Railway Company the franchise for a double track electric railway on Seventh Street from Broadway to Boyle Avenue, and on Boyle Avenue to Hollenbeck Avenue, and thence to the city limits.

Long Beach, Cal.—The Chamber of Commerce of Monrovia, Cal., has requested the Long Beach Chamber of Commerce to appoint a committee to confer with it regarding a project to construct an electric line between the two towns via Downey. The request has been granted, and the construction of the line is expected.

Tacoma, Wash.—J. D. Farrell, general manager for Harriman, in Washington, and Samuel Hill, son-in-law of James J. Hill, have taken an option on the controlling interest in the great power plant of the Hanford Irrigation and Power Company, at Priest Rapids, on the Columbia River, thirty miles northwest of Pasco. It is intended to organize a railroad company to build one hundred miles of electric railway running north and south, and connecting the Great Northern, Chicago, Milwaukee and St. Paul, Northern Coast, Norther Pacific and Hill's North Bank Railway. This railroad project will be developed by Farrell, Hill, Federal Judge Hanford, W. R. Rust, of Tacoma, and former Governor McGraw.

INCORPORATION.

Los Angeles, Cal.—The Isham Water Co. has been incorporated with a capital stock of $10,000 by A. H. Isham, Sr., S. A. Pauley, C. G. Clelland, F. M. Harrison and J. L. Wheat.

Riverside, Cal.—The Palo Verde Mutual Water Co. has been incorporated with a capital stock of $1,000,000 by A. L. Hobson, of Ventura; Frank Murphy, of Los Angeles; Percy Dennis, F. H. Thatcher and G. E. Hume.

San Francisco, Cal.—The Henderson Oil Co., with a capital stock of $500,000, has been incorporated by B. F. Brooks, T. F. Berry, T. C. Berry, H. C. Wycoff, and J. E. Garner, each subscribing one share.

FINANCIAL.

San Francisco, Cal.—The sale day of delinquent stocks of the Culiacan Electric Co. is postponed to July 9th.

Vallejo, Cal.—The Board of Trustees will receive bids up to 8 p. m., June 17th, for $85,000 worth of five per cent serial water works bonds.

Oakland, Cal.—The Oakland Oil & Asphaltum Co. has levied an assessment of one and one-half cents per share, delinquent July 3rd, sale day, July 27th.

Elsinore, Cal.—The bond issue, by which it was planned to take over the electric light system to municipal ownership, was defeated by one vote.

Chehalis, Wash.—The City Council has passed an ordinance to submit to the voters of the city at an election to be held June 30th, the question of issuing $176,000 water bonds.

San Francisco, Cal.—The Section Twenty-five Oil Co. has levied an assessment of ten cents per share on its stock, the assessment to go delinquent on July 8th, and the sale day of stock delinquent is set for August 21st.

Suisun, Cal.—The proposition to vote a special tax of $10,000 with which to buy the Freitas farm at Twin Sisters Mountain as an adjunct to the Suisun water system, was defeated at the election held to vote on the proposition.

Newport, Ore.—The City Council has adopted a resolution providing for calling a special election to raise the city's indebtedness to $50,000. The extra money is wanted for the establishing of municipal water and lighting systems.

Fullerton, Cal.—Directors of the Anaheim Union Water Company have voted to call a special election for September 12th, to vote on the matter of increasing the bonded indebtedness of the company from $75,000 to $300,000, to pay existing indebtedness and to acquire additional property and develop it.

Los Angeles, Cal.—The City Council has passed an ordinance for the issuance of bonds of the city in the sum of $1,020,000 for the purpose of acquiring and constructing waterworks for supplying the inhabitants of the city with water from Owens River, including the acquisition of lands and the construction of aqueducts, ditches, tunnels, etc. The bonds are to be in the denomination of $1,000 each.

TELEPHONES.

Quincy, Cal.—Preparations are being made by the Forest Service to install a telephone line from the headquarters at Quincy to the rangers' camp, which is being installed near Claremont, on the middle fork slope. The line will be about six miles in length.

San Francisco, Cal.—The ordinance fixing telephone rates for the coming fiscal year, providing an average reduction of ten per cent from existing charges, has been passed by the Board of Supervisors. Besides reducing the rates, the ordinance takes from the company the right to dictate as to the employment of operators on private exchange boards.

WATER WORKS.

Sonora, Cal.—The Supervisors of Tuolumne County have resolved that the Tuolumne Water Power Company be granted the privilege of laying its water pipes through the streets of Jamestown for the purpose of supplying the town with water.

Chico, Cal.—A resolution of intention to install a street sprinkling plant in the business section has been adopted, and bids have been asked for. A four-inch pipe is to be installed, to connect with the sewer pumping plant. The system will cost more than $2,000. The bids are to be opened June 24.

Madera, Cal.—City Trustees Thede and Thurman and City Engineer Smith are making an estimate of the extent and expense of installing a city water works. Every street has been gone over, and the size of mains determined. The figures will be tabulated and reported at the next meeting of the Trustees.

Fullerton, Cal.—The Trustees have accepted the offer of the Domestic Water Company to install twenty-six fire plugs on a seven-years' contract. The company agreed to rebuild its system throughout the city, using mostly eight, six and four-inch pipe, and to complete the work within sixty days in the business portion of the city. The improvements will cost about $12,000.

Los Angeles, Cal.—The Iowa Land and Water Company has taken over 16,000 acres located about 12 miles south of Corcoran, Tulare County, between the Alpaugh colony and the Santa Fe Railway. The company will immediately have developed between 4,000 and 5,000 inches of water from artesian wells, and the water will be turned into mains and lateral ditches covering the entire tract.

Pasadena, Cal.—Mayor Earley and City Attorney J. Perry Wood, representing Pasadena, and Don G. Porter and Walter S. Wright, representing water companies, have completed a contract for the sale of three leading companies to the city. The contract will be referred to the directors of the companies, and if approved it will be brought before the Council. The contract calls for an expenditure of approximately $865,-000 by the city.

San Francisco.—The water rates charged private consumers during the coming fiscal year will not exceed those provided for in the ordinance of 1902, as the Board of Supervisors has finally passed the bill submitted by Chairman Johnston, of the special Water Committee. This measure allows no increase in the private-consumer rates of 1902, the water company and organizations supporting its demand for an increase of from 14 to 15 per cent, having refused even to consider the proffer of a 12½ per cent increase. The ordinance increased the city's hydrant rate, however, from $2.00 to $2.50 a month, and also adds slightly to the allowance for school and street water service. The Board has passed to print, on the recommendation of the Public Utilities Committee, the ordinance drafted by the latter body last week, declaring that public interest and necessity demand the acquisition of a municipal water supply, calling on the Public Works Commission to secure necessary plans and estimates through the Bureau of Engineering, and designating Lake Eleanor, the Hetch-Hetchy Valley and the Tuolumne River as available sources of supply.

OIL.

Long Beach, Cal.—The city is advertising for sealed bids for the purchase of an oil pipe line franchise, to be received to July 9.

Salt Lake, Utah.—Secretary J. E. Busch, of the Virgin Oil and Development Company, has received a telegram from Superintendent Hallohan, saying that a 40-barrel well has been struck in the Virgin River oil district in Washington County.

Albuquerque, N. M.—The entire plant of the Continental Oil Company, with the exception of the office, burned June 12. Nearly 100,000 gallons of kerosene, gasoline and naphtha were destroyed, the total loss being about $50,000.

Fresno, Cal.—A large number of claims have been filed here during the past few months as the result of new discoveries of oil in the district west of Mendota, known as the Little Panoche district. It is thought that the new discovery will out-rival the Coalinga field. The discovery of oil in Clovis, ten miles west of Fresno, brought Expert Carter, of the Standard Oil Company, down to inspect the strike, and his report was very encouraging. A high grade of oil has been struck by a company composed of Fresno men. Their holdings are located at Kern, and extend to the Midway field.

Los Angeles, Cal.—A second well is to be started at once, 800 feet west of the Amalgamated's latest producer, just beyond the Los Angeles-Pacific track, crossing the field to Sherman. The rig was put up about a week ago. The newly completed well has sanded up after flowing a number of days. Men are cleaning it out, and will try to find the source of the inrush of salt water that threatened to play havoc with its output. The gas pressure has been terrific, and the trouble impossible to investigate before. It was thought for a time that the whole field was endangered by the salt water that gushed from this well.

Port Costa.—The new Southern Pacific rifled pipe line for conveying heavy fuel oil from Oil City, in the San Joaquin Valley, northward to Port Costa, a distance of 285 miles, is being rapidly completed at an expense of about $5,000,000. The Associated Oil Company is the nominal owner and constructor of the plant. Engineer Isaacs, of the Southern Pacific, is the inventor of the rifled pipe, which gives the oil a revolving motion, thus enabling it to be cheaply and easily pumped long distances. When the new line is completed the company will be able to supply the locomotives with oil at a transportation cost, which will be almost infinitesimal when compared with the cost of transporting it in cars. The oil which is now being transported by the new device comes from the Kern oil fields, near Bakersfield, and has a density of 14 degrees Baume. Owing to the cost of freightage various attempts were made to send it through pipe lines, but it was found that the pumping pressure demanded was too great until the invention of the rifled pipe. The tests of the line that have so far been made between Vulcan and Hunt have been very successful, and the company is now preparing to test the line between Hunt and Quail, work to begin some time this week. The pumps being used have a pressure of 800 pounds, capable of pumping 20,000 barrels a day for a distance of 28 miles.

POWER AND LIGHT PLANTS.

Aberdeen, Wash.—The Grays Harbor Gas Company will commence soon on repairs and additions to its plant that will double the capacity of the works.

Seattle, Wash.—B. Van Asselt, of this city, is working on the formation of a local company to build a gas plant at Georgetown and will apply to the Georgetown City Council for a franchise within a short time.

North Yakima, Wash.—Williams & Baker, who have installed central heating plants in a number of the cities of the Northwest, are organizing a joint stock company here with a capital of $100,000, to establish a plant before next winter, having a capacity of 180,000 square feet of radiation.

Tacoma, Wash.—By a resolution presented by Councilman Hawthorne, the City Council last night authorized the commissioner of public works to advertise for bids on furnishing the city with a water-power plant of 10,000 horsepower capacity and capable of further development to at least 20,000 horsepower.

Grangeville, Idaho.—The dam on the south fork of the Clearwater River, which supplied power for the Grangeville Electric Light & Power Company, was carried away by floods. Because of the rising waters it is impossible to determine the loss to the company, but it is estimated at not less than $50,000.

Sandpoint, Idaho.—At a meeting of the City Council the Pend d'Oreille Iron Works was granted an extension to its gas franchise until January 1, 1909, with the understanding that it files a bond of $1,000 to guarantee that the gas pipes will be laid and the plant in operation before the expiration of the extension.

Marblemount, Wash.—Among other signs of activity is the beginning of development work on the Skagit Power Company's project in the canyon. The company has control of eight miles of the stream and will be able to develop the greatest horsepower plant on Puget Sound. It is estimated that it can develop from 75,000 to 100,000 horsepower.

Seattle, Wash.—The State of Washington has taken out two permits with the superintendent of buildings, one calling for a one-story brick power house 40x80, to cost $16,500, to be built after plans by Howard & Galloway, architects, on the University campus, and the other calling for the installation of the machinery in the same, at a cost of $77,000.

Walla Walla, Wash.—Announcement has been made that rights of way for a power house, flume and water privileges on the south fork of the Walla Walla River several miles above the present power plant of the Northwestern Gas & Electric Company have been secured by the trustees of the Washington & Oregon Traction Company, which intends to build a 5,000-horsepower plant in the near future.

Seattle, Wash.—The university regents let the contract for the university power house and plant. The award for the construction of the power house was made to H. Chase & Co., for $16,667. The walls of the building will be of paving brick and the roof will be of slate. The Hallidie Machinery Company obtained the contract for the apparatus to be installed in the building for $72,900. Chase & Co. began work on their contract and expect to have the building ready for use for the fall term.

ELECTRIC RAILWAYS.

Rosalia, Wash.—The Spokane Inland Electric Railroad has plans and specifications for a fine new depot at this place. The building will be of brick and will cost $10,000. Work will begin at once. The new building will be a bungalow in appearance.

Vancouver, Wash.—The Vancouver Traction Company, with capital stock of $125,000, has taken over the Vancouver street railway system and will complete the line in the city and extend the system into the country for thirty miles, to be followed later by branch lines in various directions.

Ellensburg, Wash.—A. A. Nichols and August Sassa have petitioned the council of Roslyn, Wash., for a franchise for a street railway which they expect to build between Roslyn and Cle-Elum, Wash. The promoters say that they will begin work within ninety days and will complete the road in eighteen months.

Coulee City, Wash.—James Fullerton, of Seattle, promoter of the electric railroad between this city and the Columbia River, secured a franchise from the county commissioners and has applied to the City Council for a franchise here. He says that the money has been secured to build the road and that work will begin before September 1st.

Spokane, Wash.—A third survey has been made by the Panhandle Electric Railway & River Company for a proposed electric line to run from Priest River to Priest Lake. Leading stockholders of the company state that money to build the road has been pledged by Eastern capitalists and that the work of construction will be started at an early date.

Nez Perce, Idaho.—A deal was closed here recently for the construction of an electric line from this city to connect with the Northern Pacific Culdesac-Grangeville line in the vicinity of Vollmer. The line will be constructed by Z. A. Johnson. The proposition accepted by Nez Perce people provides for a bonus of $50,000 to be paid when the road is completed. The estimated cost of the road is $150,000.

Nampa, Idaho—The Boise Valley Electric Railway line, connecting this town with the capital city, is soon to be completed. The graders are now at work in the northeastern part of town in the vicinity of the sugar factory. Robert Noble, president of the road, states that the road will be pushed to completion. The plans of the company are to continue the line south and west of here to tap the Deer Flat section on the Payette-Boise reclamation project, and to make Caldwell the western terminus.

Vancouver, Wash.—Completion of the Vancouver Electric Railway, with branch lines to the interior of Clarke County, is promised by the filing of incorporation papers here by the Vancouver Traction Company. The incorporators are Senator E. M. Rands, this city; W. J. Patterson, Baker City, and A. Welch, of the Portland-Salem (Ore.) electric line. The completion of the system already under way will begin at once and extensions to the fruit and dairy sections of the county made as fast as the management deems advisable.

Ellensburg, Wash.—Another telephone company has been organized in this valley under the name of the North Kittitas Telephone Company. The following were elected officers: J. H. Moore, president; N. Rollinger, treasurer; N. W. Gehlen, secretary. The line will be six and a half miles long.

Classified List of Advertisers

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General Electric Co.
Standard Electrical Works.
Western Electric Co.

Aluminum Electrical Conductors
Pierson, Roeding & Co.

Annunciators
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Asbestos Products
Johns-Manville Co., H. W.

Bases and Fittings
Chase-Shawmut Co.

Batteries, Primary
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Boilers
Keystone Boiler Works
Moore, C. C. & Co., Inc.
Robb-Mumford Boiler Co.
Standard Electrical Works
Tracy Engineering Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
General Electric Co.
Northern Electrical Mfg. Co.

Building Material
Bonestell, Richardson & Co.
Johns-Manville Co., H. W.
Paraffine Paint Co.

Cable Connections
Dossert & Co.

Carbons
Reisinger, Hugo

Cable Clips and Hangers
Chase-Shawmut Co.

Circuit Breakers
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works.
Sterling Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.

Conduits
American Circular Loom Co.
Electric Appliance Co.
National Conduit & Cable Co.
Pierson, Roeding & Co.
Standard Electrical Works.
Sterling Electric Co.

Conduit and Moulding Hangers.
Chase-Shawmut Co.

Conduit Fixtures
Bossert Electrical Con. Co.
Electric Appliance Co.
Standard Electrical Works.
Sterling Electric Co.

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O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Electric Appliance Co.
Sterling Electric Co.

Dynamos and Motors
Brooks-Follis Elec. Corp.
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Grinders
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Western Electric Co.

Electric Heating Devices
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.
Vulcan Electric Heating Co.

Electrical Instruments
Cutter Co., The
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kierulff, Jr. & Co.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
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Crocker-Wheeler Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
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Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
General Electric Co.
B. F. Kierulff, Jr. & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Brooks-Follis Elec. Corp.
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co
Standard Electrical Works
Johns-Manville Co., H. W.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Western Electric Co.

Electric Ventilating Fans
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Engineers, Chemical
Moore & Co., Chas. C., Inc.
Smith, Emery & Co.
Standard Electrical Works
Tracy Engineering Co.
Westinghouse Machine Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.

Engineers and Contractors
Brooks-Follis Elec. Corp.
Cory, C. L.
Copeland, Clem A.
Goeriz & Co. O. C.
General Electric Co.
Jackson, D. C. & W. B.
Moore, C. C. & Co., Inc.
Smith, Emery & Co.
Standard Electrical Works
Sterling Electric Co.
Thaxter, H. C.
Tracy Engineering Co.
Van Norden, Rudolph W.
Western Electric Co.
Westinghouse Elec. & Mfg Co.

Feed Water Heaters and Purifiers
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.
C. H. Wheeler Mfg. Co.

Fire Proofing
Johns-Manville Co., H. W.

Fuses and Fuse Devices
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Ground Connection Clamps
Chase-Shawmut Co.

House Goods
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.

Hydraulic Machinery
Goeriz & Co., O. C.
Moore, Chas. C. Co., Inc.
Pelton Water Wheel Co.
Standard Electrical Works.
Tracy Engineering Co.

Injectors
Vulcan Iron Works

(Continued on 2nd page following.)

THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

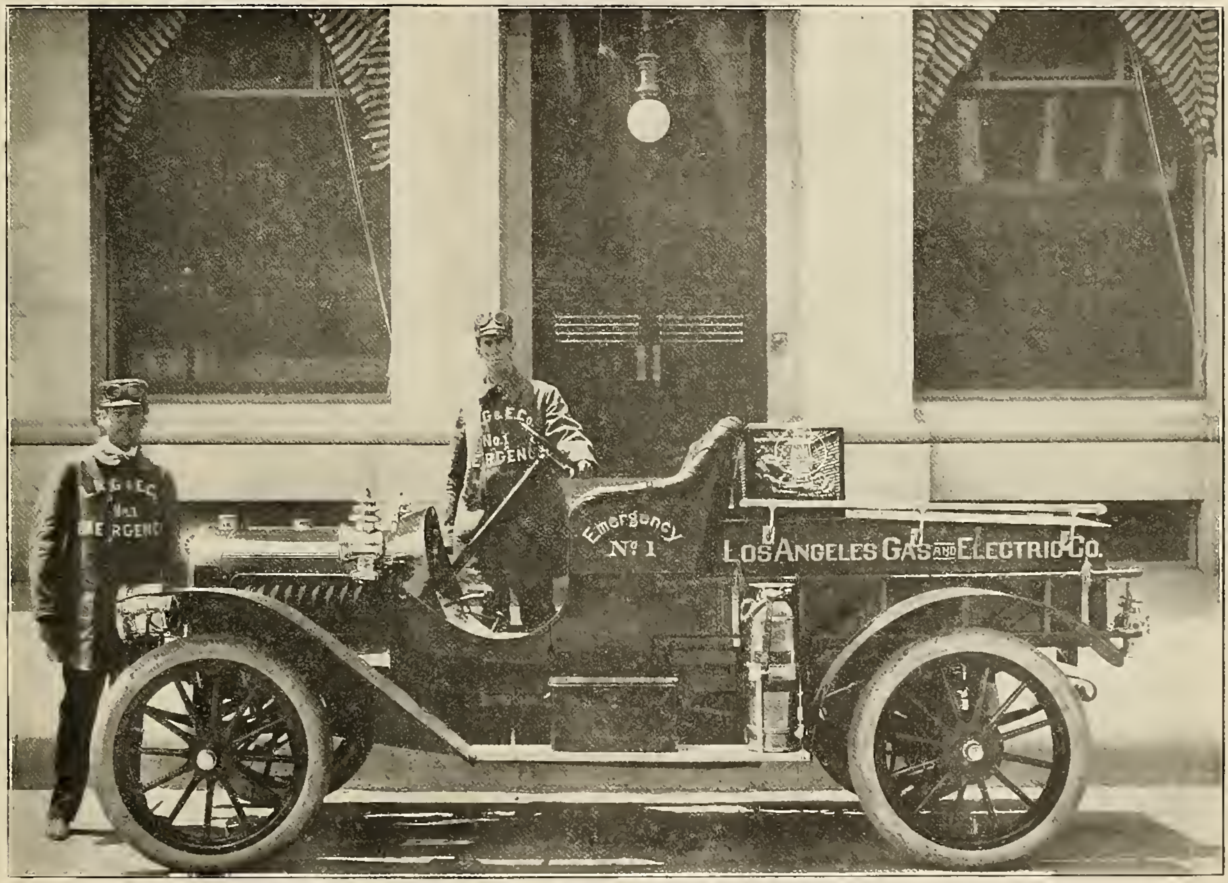
VOLUME XX. SAN FRANCISCO, CAL., JUNE 27, 1908 No. 26

LOS ANGELES FIRE AUTOMOBILE.

The rapidity with which an automobile can respond to a fire alarm is being recognized as an important factor in preventing fire loss. Many automobiles have been installed for the use of the fire chiefs in the various cities of this country, and we recently illustrated and described the complete auto fire-fighting department in Berlin, Germany. While not quite up to the foreign standard, we believe the accompanying illustration of a fire-fighting automobile just put into operation in Los Angeles, will be of interest to our readers.

Furthermore, it is an example of the progressiveness of the Los Angeles Gas & Electric Company, which has equipped the car primarily to promptly attend to the complaints of their subscribers. The crew has also been instructed to respond to fire calls, an alarm having been installed for their convenience. This will be a great help to the fire department, not only in looking after live wires and gas pipes in burning buildings, but also in suppressing a fire in its early stages.

Replacing the tonneau of a 30-horsepower Rambler machine, is a large box equipped with emergency tools. Besides a small chemical fire extinguisher, these include hammers, picks, shovels, chisels, wrenches, rubber gloves, electric searchlights, saws, screw-drivers, caulking irons, safety helmets, and a kit of medicines and bandages. A tank of oxygen, carried on the side, is available to rescusitate any case of asphyxiation.



EMERGENCY AUTOMOBILE LOS ANGELES GAS AND ELECTRIC CO.

The car is manned by two shifts of four men, ready for service both day and night. In responding to an alarm, the car has the right-of-way on the street, and is equipped with a ten-inch fire-gong.

In response to a telephoned notification of trouble from defective wiring or a gas leak, upon reaching the scene, the men ascertain the cause and make the necessary repairs. Before returning ,the crew first communicates with the station, to ascertain if any orders have been received during their absence. In case of damage to the street main or service pipes, the driver can get aid from the company's employees living near-by, being provided with a list of their addresses.

DISCUSSION.

LIGHTNING ARRESTERS AND DESCRIPTION OF A NEW FORM OF CIRCUIT BREAKER.*

The Chairman—We have all listened with a great deal of interest to Mr. Bowie's very thorough and complete paper on this subject, and I think we owe him a vote of thanks for the efforts he has made in giving us this paper.

We have with us a number of representatives of the multigap arresters. I would like to hear from Mr. Heise something about multigap arresters.

Mr. Heise—I think that Mr. Lamme can take that up better than I can.

The Chairman—Mr. Lamme, can you tell us something about multigap arresters?

Mr. Lamme—I have not prepared anything at all. But I was very much impressed by Mr. Bowie's paper. I am a little in the position that I was in as a boy in Sunday school—a man that didn't have anything, and what he had was taken away from him. I never claimed to know anything about lightning arresters, and I have listened to Mr. Bowie's paper, and I know less.

Lightning arresters of many kinds have been made. We have the multigap arrester, the horn-type arrester, and the electrolytic arrester. I do not know which is the best; all types have worked successfully, and, so far as I know, all types have failed. Lightning is a thing that you cannot count on for sure. The lightning arresters, as the manufacturers look upon them, have two purposes; one is to protect the lines from lightning discharges; another is to take off static disturbances. The multigap arrester in this latter respect seems to have been a great success, in the matter of taking off static disturbances; but many times this multigap arrester has failed in taking off heavy lightning discharges. The newer type of arrester, the electrolytic arrester, seems to be quite a success at the present day, and seems to have a feature which the old arrester did not have—that is, it has very much less induction in the circuit. The great objection to the old types was induction in the ground line; that caused it to fail in taking off lightning discharges.

The Chairman—While we have correctly stated that all kinds of arresters have been tried, and that they have all failed, I think we are particularly fortunate in this section, that we are not troubled to any great extent with lightning. The occurrences where damage has occurred from lightning are comparatively few, although they seem to be on the increase, and we may at some future time have to pay a little more attention to arresters than has been in the past.

There is one thing in connection with Mr. Bowie's lantern slides which was quite noticeable, and that is the flare which he had to the horns of this particular circuit-breaker; they seemed to go up very nearly parallel. I would like to ask Mr. Bowie if he has tried any particular curve on those arresters, any particular flare? Have you found any one better than another?

Mr. Bowie—I have worked out a curve which operated well in practice, depending on the load and on the voltage.

The Chairman—The meeting is open for discussion, and we would be glad to hear from any one who has anything to say on the matter. We have a great number present who have had a good deal of experience with different arresters. Mr. Dunn, I believe, has had a great deal of experience, and we would like to hear something from him.

Mr. Dunn—There is one thing about lightning arresters about which nothing has been said in all the papers presented, and that is in regard to the method of installation. That is equally as important as the arrester itself, and sometimes more so. Many arresters have been condemned for that one reason. The frequency of lightning discharges is excessively high, and if the arresters are put in with very liberal copper in them, direct to ground, I think we would have much less trouble with arresters, as they are installed. I think that is one very important feature that is not brought out, even in papers before the Institute.

The Chairman—I think Mr. Dunn is quite right in stating that a great many installations have been made—and I, myself, have seen them—where an iron wire has been run to a gas-pipe. Mr. Lamme has stated that lightning arresters serve a double purpose, and while in this particular section we are not troubled to a great extent with lightning, they do serve the purpose of taking care of what is called surges in the lines due to switching or shorts. There has been a great deal of trouble from that source; in fact, a great deal more from that source than from the lightning itself.

Mr. Kershner, I believe, is here. He has had considerable experience down in Mexico. Can he tell us something about how the lightning affects plants down in that country?

Mr. Kershner—I cannot say very much about lightning in Mexico. We did have some experience down there with a Westinghouse Multigap Arrester. I have in mind one case where a line seven kilometers long went up a mountain to a mine. There was generally a considerable disturbance at the lower end of that line, not only due to lightning, but also due to static conditions. We had more experience with lightning back in Pittsburg than almost any other place I can recall. Mr. Wirtz and Mr. Thomas did some practical work back there. I remember particularly the first lightning arresters that were ever installed on the Pittsburg and McKeesport line, and the time they had there some years ago. The construction was such that it was nothing uncommon for the local traction company to have from forty to sixty cars put out of commission in a single storm, generally by puncture in the armature. But that has largely been overcome by lightning arresters used on low-potential circuits and guarding the high-potential circuits.

The Chairman—Mr. Burkett, can you tell us something about how to protect telephone lines from lightning? What sort of an arrester do you use on your lines?

Mr. Burkett—Mr. Chairman, I had not thought of saying anything. I will say that the matter of the protection of telephone lines from danger from high-potential discharges is one that has received a great deal of thought, and we have in a way standardized by protecting only to one thousand volts. We have almost concluded that it is impossible to protect beyond that from actual contact with high-potential wires. The standard practice in telephone work to-day, is to protect the central-office apparatus from low-tension current, and that is done very effectively, so effectively that we very seldom lose any apparatus in our central offices from physical contact or from lightning Speaking of all the telephone central offices in the United States, it is very rare that we ever have any fires or any destruction of central-office equipment; which would indicate that the protection that is in universal use, and has been standardized within the last ten years, is remarkably efficient. The protection used consists of three parts: The first part consists of the well-known tubular fuse, and the

*Paper read May 29, 1908, at meeting of San Francisco Section, American Institute of Electrical Engineers.

second part (which is a part of this fuse really, or a part of the protection) consists of an open space or an air-gap arrester, one phase of which is connected directly to earth, and the third part consists of a coil protecting against sneak current, low-voltage crosses or high-resistance crosses The mere fact that telephone wires enter pretty nearly all structures in every community to-day, makes the protection of those wires or makes the protection of those structures quite a vital matter, and we very religiously install a protection on all wires that are exposed that enter all structures. This protection has proven very efficient, indeed. In the thousands of wires that enter structures in all communities, we have very few cases where it has been proven and where it actually occurred, where we are sure that the structures have suffered from any kind of current being carried over our protective apparatus. This apparatus, like the apparatus in the central offices, consists of the cut-out, and where the circuit is a closed circuit through the telephone instrument, we use, in addition, three coils.

I was rather interested, Mr. Chairman, in one statement that you made that I do not know quite whether I understood or not. You said that in this section it seemed that more trouble was being experienced from lightning recently than had been in the past. I am wondering if you meant that the conditions were such that there was more lightning, or simply that there were more opportunities to have trouble with lightning than before.

The Chairman—What I had reference to, was that during the last two or three years there seemed to be—at any rate, the lightning disturbances have increased. I do not know whether that has been noticeable on your lines or not. But on the long-distance transmission lines, no protection—I say "No," very little protection—is ever given those lines from lightning discharges. In the early days of the California Gas & Electric Corporation, they put in a great many lightning arresters, thinking that it was absolutely necessary to protect the apparatus from lightning. Our experience with that apparatus has been rather a sad one. It kept us busy keeping the apparatus in shape to take care of the lightning discharges, and more often it would be damaged and put out of commission before any lightning came, by the surges in the line. We have had lightning or high-potential discharges come in over the lines a great many times. Very often they will jump from the terminal of the transformer to the case of the transformer, which is grounded, before it would go into the transformer, the transformer acting as the choke coil.

Mr. Hall, I believe, is with us. We would like to hear something about the experiences in New York. I believe Mr. Hall has had considerable experience in that city.

Mr. Hall—In regard to my experience in New York, Mr. Chairman, I have not had much with lightning arresters; I was connected with companies that were operating entirely an under-ground system, where we did not have any trouble with lightning. The only trouble we had was due to static conditions and discharges. I was with the Interborough Company, and they had static arresters installed, but we took those out—found that they gave more trouble than good. So they were taken out, and we operated entirely without the static arresters. And the New York Central did not install static arresters. Those were the two companies I was connected with there, and I had no experience whatever outside of them.

The Chairman—You had nothing at all to take care of these static disturbances?

Mr. Hall—No, sir. We had the arresters all burned out in one trouble we had there, and so we took them all out and did not use them.

The Chairman—Mr. White, I believe, is here, and has had considerable experience up in the mountains, on the lines of the American River Company.

Mr. White—I agree with Mr. Bowie and Mr. Dunn, that a great deal depends on the manner in which lightning arresters are installed, and in the existing conditions of the system. We had a rather peculiar experience; although it is not considered on the Pacific Coast that we have much lightning, my experience has been considerable with lightning out here. We had the regular horn type of lightning arresters, and the horns were set at an angle of fifty degrees, in the form of a parabola. The output of the plant was about five thousand kilowatts. When I first went with the American River Electric Co., we had porcelain jars of water with oil above as resistance. The first three months I believe our bills for porcelain jars were more than the cost of the lightning arresters. That is practically all my experience in California. However, since that time I was with the Nevada County Power Company for about a year, and there our lightning conditions were very severe. In Goldfield sub-station, at one time I counted twenty-two lightning discharges in half an hour—that is, due partly to lightning and partly to surges in the line. Our line varied in altitude from fifty-five hundred feet to ten thousand feet and then dropped down to four thousand at the plant. We noticed on this system that a great many of our lightning discharges were due to static conditions on account of the altitude. We made a number of tests in Goldfield, to determine what type of lightning arrester we would install. At the time we went there our load was something like eighteen hundred kilowatts, and afterwards increased to thirty-two hundred kilowatts. We had in our sub-station a multigap arrester, and kept it in service for about three weeks, and during that time, in which the lightning made a considerable number of discharges, we had much difficulty in keeping a man in the sub-station. The main thing with us was to keep the lines going; we could not afford to allow the service to be off the line. From February, the year before last, until April, last year, the current was only off the line once—due to a wash-out. During that time we had something in the neighborhood of twenty-five or thirty heavy lightning storms, and we lost no transformers. I could stand in the sub-station and watch the heat lightning and see the volt-meter vary from a half to three volts, simply due to the static condition of the air. As the capacity of our plant increased, we found that it was more advisable to change the angle of our horns. When we first started we had an angle of forty-eight degrees, the horns being constructed in the form of a parabola, and later we changed it to fifty-five degrees. If the plant increased to fifty kilowatts, it would probably necessitate a different type of lightning arrester. I believe the tendency is towards outdoor lightning arresters and outdoor switching, and I think the horn type of lightning arrester in combination with the electrolytic, will be preferable for transmission purposes on this Coast.

The Chairman—When those arresters discharged, Mr. White, was there any interruption to service, or was it merely a drop in voltage, and not an interruption?

Mr. White—Merely a rise or fall in the voltage. We noticed another thing, also: Our system in the latter part grew very rapidly. We had a line of one hundred and ten miles in length, transmitting at fifty-five thousand voltage, and the static conditions caused a maximum variation at that time. As we kept adding sub-stations to the lines, the static conditions gradually fell off. We noticed another thing, too: We had a station at Palmetto; at Silver Peak

we had another one; at Millers, another one; and at Goldfield, another sub-station. If we left the transformers in circuit, we did not notice the static conditions, but if we cut out any of those transformers, it would multiply the static disturbances at the other point. We used the Baum type of disconnecting switch, and also oil switches. At one time there was no sub-station on the line, except Goldfield. We pulled the oil switch and it caused the lightning arresters to go over. That would seem to show that it caused a higher rise in the voltage than with the Baum air switch.

The Chairman—You would open the circuit with the air switch without drawing any arc?

Mr. White—Without drawing any arc. Of course, the arc would follow the switch as it opened up, but as Mr. Bowie stated, the air-brake switch would open it so much more quickly.

The Chairman—I would like to ask the voltage of that switch?

Mr. White—Fifty-five thousand.

The Chairman—I would say that I had an experience similar to the one Mr. White spoke of, on the other side of the mountains, where there was a great deal of trouble with what they called heat lightning. It would be perfectly clear and bright in the morning, and along about one o'clock there would be a little cloud, and inside of a half-hour we would generally be shut down. That was generally due to lightning disturbances, because the arresters were not put in proper shape. No particular care was ever paid to the grounds. Plates were buried in dry, rocky soil; and we finally overhauled the lightning-arrester equipment throughout; made a better ground by burying a plate about ten or twelve feet, and dumping in several cartloads of fine charcoal, and also putting a stream of water right in on top of the charcoal, so as always to have it wet. That, to a great extent, eliminated the lightning troubles. We used no choke coils at all. We were not able to overcome it entirely by the arresters. Oftentimes we found it advisable to shut down until the storm had blown over. As soon as it started to rain, everything was all right. The static seemed to dissipate in the atmosphere when it started to rain.

Mr. White—To give an idea of the static: One time we were at work on a line, and we threw a chain across it to ground it thoroughly, and drove a crow-bar into the ground and poured water on the crow-bar, and while we were working, lightning struck the wire and knocked a man off of it. So that the static condition of the atmosphere is very favorable to lightning disturbances.

The Chairman—Mr. Jorgenson, can you give us anything on this subject?

L. Jorgenson—Lightning phenomena I have not studied much during the last few years, for two reasons: First, our knowledge is incomplete, and what there has been written about it is yet in an undigestible form; second, as long as I am living in God's country it does not worry me much, as we have no lightning to speak of here. A set of multigap arresters on each line in the power houses I should think would be sufficient.

Mr. Bowie's circuit breaker of the horn type will, undoubtedly, do the work of breaking a high-voltage circuit satisfactorily when this circuit is carrying but little or no load, but when it comes to main lines carrying 10,000 kilowatts and up, nothing but the best oil switches are good enough, especially if it is desired to have these switches automatically operated. This feature requires the switch to stand greater strains and shocks than a hand-operated one. In both the oil and the air switch we have an arc form between the contacts as they are separated. An arc inserted in a circuit causes a deformation of the wave form of the current. This is the equivalent of a superposition of one or more harmonies of currents of higher frequency on the fundamental, and will cause a rise in potential. In an oil switch the length of the arc between the separating contacts is only a few inches; in an open air switch, however, the arc is very long, somewhat less than half a mile, if a considerable load is opened.

The best switch on the market for heavy-transmission line work, are the Form H and the Type C switches, manufactured by the two big electric companies. Both work on the same principle. The break takes place in an oil-filled enclosed space practically air-tight; the arc forces the oil away to begin with, until the air on top of the oil is compressed enough to force the oil back again to put out the arc. The pressure in the switch rises as high as 150 pounds per square inch, when breaking a heavy load; this is easily taken care of in the mechanical construction of the switch.

Smaller switches are not provided with air-tight oil vessels. In fact, they are ventilated. This avoids the heavy mechanical construction, as no pressure can rise in them. But these switches cannot be used to break heavy loads, if it is desired to have them keep their contents of oil inside the vessel.

An oil switch (H and C) opens the circuit in about one-fifth of a second; on a 60-cycle system, twelve cycles would pass through the switch in this time, giving the arc many chances to break at zero current. It seems reasonable to assume that the arc breaks at times where the current wave passes through zero, as the power is zero for the moment being. This, of course, also holds true for any open-air switch. But, if a circuit is subjected to rise in voltage, caused by the arc effect of the switching apparatus, the rise will undoubtedly be the greatest where the arc is the longest, and on circuits carrying 10,000 or more kilowatts it would be and is practically impossible to open the circuit with anything else than an oil switch.

High-voltage switches of different construction have been developed in California, I might say, of necessity. In this part of the country the first high-voltage plants were constructed, and each engineer had to build his own switches. The first ones were the Horn type air switches, and a little later came the oil switch. This latter was pretty good electrically, but weak mechanically, and, therefore, not adapted to automatic operation; probably this accounts for the fact that very few systems operate with automatic attachment to the main-line switches on this Coast. However, in the last few years the high-voltage switches have been so perfected mechanically that they are capable of handling the circuit automatically. The Form H switch operates excellently on 60,000 volts. The only objection to its use is that it requires a very large space, and is expensive.

For my part, I don't consider a power-house installation to be first-class if the main switches are not provided with automatic operating devices. On the out-going feeders from the generating stations, feeding into a system of substations, inverse time-limit overload relays should be provided, set to operate at, say, twice full load in 1.5 seconds. These relays would operate in a much shorter time on a dead short.

In sub-stations tapping two lines, each branch should be provided with an inverse time-limit overload relay, the same as in the main station, only set for much lighter load, say, twice the probable sub-station load, and at this load set to operate in one-half second. In case of a short in the sub-station, the relay here would trip its switch before the relay in the power house got time to operate, even in case the short was heavy enough to make the relay start to move its armature (core). As soon as the sub-station switch had opened the short behind it, everything would go back to normal conditions, and no one would notice anything along the line. In case of a short on one feeder, the relay in the main stations would cut out this feeder and only the load on this feeder would be cut off, which load could be switched over on the other lines still in commission, in very little time.

Without automatic control, several feeders would generally have to be opened by hand at the generating stations, and, when the defective one was found, the station could be started again on the clear ones. Every customer on the system would notice this operation.

This system of relays will work excellently only as long as the whole sub-station load can be taken from one line at the time, or each line feeding separate busbars, or if two or more lines feed the same busbars, they should be sectionalized and each line feed a separate section. This is a condition which in nearly all cases could be complied with.

If, however, the buses must be paralleled in the sub-station, the inverse time-limit overload relays here would not work as intended at all times, and reverse-current relays should take their places. The inverse time-limit overload relay has reached the finish of its development; the reverse-current relay has not; therefore, installations should be made to suit the former where possible; this is not difficult in systems with only two main feeders in parallel at one time.

The Chairman—I think the one great objection to the air-switch is the room that it takes up. Where you operate an air-switch on a high-voltage line, you necessarily have to give a considerable spacing to the different lays of the switch. If you have a switching station where you have, say, six or eight three-pole switches, and real estate is very high, why, you will find that your switching equipment is going to run into money very fast, and that is one of the reasons why the oil switch has been developed to where it is. A little while ago we had some trouble with one of our oil switches. The corporation makes its own switches, and they consist of rotating arms. The rotating shaft carries the arm below, the arm being insulated from the shaft by a bushing. This particular bushing was faulty, and after being in service for a while it broke down. The switch was located in a reinforced concrete building, along with five other switches. When it broke down it blew the oil out of the switch, and the concussion in the station was so great that it blew out every one of the glasses where the line enters the building. We used a thirty-six-inch glass with a wire coming through a hole put in the middle of the glasses. Every one of those glasses was blown right out. When Mr. Jorgenson referred to the ideal switch having an air chamber, you might say, where the air would be pressed when the circuit was broken and the gas is given off, I was wondering what the effect would be if you had any trouble similar to the one I have mentioned.

Mr. Jorgenson—You never have any trouble in a thousand-dollar switch. (Laughter.)

The Chairman—Mr. Charters is here from Stanford University, and we should like to hear something from him on this subject.

Mr. Charters—My experience with lightning arresters has been absolutely nil. I would suggest one thing with reference to the statement that has been made here this evening, of the fact that the trouble stopped as soon as it started to rain, in Nevada. On Italian lines they use a stream of water in connection with the lines, which is continually dropping, the static conditions being carried off by the water. They not only have the carrying off of the static discharge in that way by water, but that is very materially assisted by the rain dropping off the insulators. I believe the fact exists that lightning is usually more severe before the rain actually commences to fall, because the lightning charge, of course, gets its force from the individual drops in the clouds, and as soon as the fall commences and the moisture descends as rain, the static charge in the clouds is reduced, and the tendency would be toward a reduction in pressure after the rain commences to fall. Then, in regard to the trouble at different altitudes: The original investigators, at the time when they worked with static machines, experimented with wires at different altitudes, quite frequently a kite put up to a certain height would discharge continuously and at frequent intervals, with no clouds in sight, and a perfectly clear atmosphere. The only explanation they could afford was that the ascending currents of air—that is, the cold parts going up and the warm parts coming down, would create frictional electricity, which would be carried off by the wire. And there is an account of a Russian experimenter who was killed, I believe. I think we might find, if we went back to some of those old accounts, a point which might be of benefit in taking up this discussion of lightning arresters.

The Chairman.—I believe Mr. Anderson, of the Westinghouse Company, is here. Maybe he can tell us something about lightning arresters. Mr. Anderson, can you tell us anything about your experience with lightning arresters?

Mr. Anderson—I have seen almost all of them break down, though many will stand a heavy discharge. There was more trouble keeping the old type from catching fire than to keep the lightning out of the station. I believe most of the old engineers had the same trouble. In one case, where we had a fuse in the oil tank, between the busbars and the lightning arrester, it not only blew the wooden tanks all to pieces, but blew all the tacks out of the iron, where it was tacked, so as to keep it away from the woodwork. With the old type of choke bar, you often had to shut the station down and throw them out of doors. In Southern California, they do not have a great deal of lightning, but have more trouble with the transformers. With regard to lightning entering the series transformers on the lines for instruments, it would go quicker through them to ground and get to ground before it got to the lightning arresters. I am a good deal in favor of Mr. Bowie's suggestion to keep the arresters out of doors and away from the buildings entirely. There have been a great many different arresters tried, but I could not say which one is better than any other. We have not seen so much of the new electrolytic. The experiments back at Buffalo, I believe, were very successful, but I do not think out here there are any installed yet.

The Chairman—There does not seem to be any question but what the old horn-type arrester seems to be more fully approved and safer than any other that is on the market. They have proven themselves to be efficient in most cases where they have been installed properly. There is one thing that power companies have to contend with on telephone lines, and that is the matter of getting the telephone wires into the transmission wires. It is customary

to carry a telephone circuit on most important lines carrying high-tension power, and it is not an unusual occurrence by any means to get the telephone wire up into the transmission wire. That would at first seem to be quite a serious matter, but in practice it is not. It is taken care of by simply using small carbon plates separated, probably, a sixty-fourth of an inch or possibly a thirty-second, depending entirely upon the condition of the telephone line. If it is installed properly and balanced statically, there is not a great deal of trouble. If that telephone wire should by any chance get into the transmission wire, it simply jumps across the circuit gap, and goes to the ground, one of the carbon plates being grounded; and it is an unusual occurrence even to lose a coil in an extension bell in cases of that kind. If your telephone gets on to your transmission line, and stays there too long, your carbon plates get too hot, and when that happens, you simply pull at your cut-off and let it go. While theoretically that looks to be a very serious matter, in practice it is very easily taken care of, and does not cause any trouble whatever. Has anybody else anything to say on this subject?

Mr. Bowie—With reference to the remarks of Mr. Jorgenson about the air switch: I have had air switches on lines carrying up to ten thousand horsepower. On one occasion the operator threw together two stations of ten thousand horsepower combined capacity, which were left out of phase. He realized that he had made a mistake, and opened his switch immediately. It happened with so little disturbance that he thought everything was all right, and he put the switch back again and shut down both powerhouses. That was a pretty severe test of the switch. The arc was not over seven feet long.

Another matter, about the location of the switch: Of course, they can be located on top of the building. The location out of doors, though, is quite an important feature, in my mind. There is no switch in the world that may not break down at some time, and if it does break down, if it is out of doors, it will do as little damage as possible.

Mr. Kershner—I was going to state that there have been some remarks made here this evening about the lightning arresters always breaking down, and especially in the case of a direct discharge, so called in the papers. I think this whole thing has come to the front recently on account of the high-potential lines in the East. The tank arrester is pretty safe. While that has turned out perfect, yet it is not possible to say that you have protection against direct discharge of lightning. A naval officer tells of a wooden ship with a lightning rod on a wooden mast. In the tropic waters in the South Pacific, a direct discharge came on the lightning conductor, which in this case consisted of a proper cable three-quarters of an inch in diameter. The discharge came down the mast to the deck of the ship and jumped from the lightning conductor to the deck, and then jumped back again to the lightning arrester and killed a man in the lower part of the ship, who was at the end of it. I do not think you will find anything compared to a three-quarter-inch cable. If the lightning arrester does what it has been asked to do in the line of relieving internal pressure, I think it is all it can be asked to do.

Mr. White—There is one point about the multigap arrester which has not been touched upon: When the manufacturer sends it out, he sends it out with sufficient gaps for ungrounded lines, and if you ground the neutral, you have to shut out a certain number of the gaps to make it satisfactory. I know in one case we found the gaps consisted of fifty-six gaps, and we had to cut half of them off in order to make it operate at fifty-five thousand volts. That may explain the failure in some cases.

The Chairman—Improper insulation again?

Mr. White—Possibly improper insulation and perhaps not following instructions.

A Member—I would like to ask if lightning ever jumps an insulator?

The Chairman—It may; but we have had practically no poles destroyed from lightning—occasionally one, but so very, very few that we do not consider them. I do not know of any insulators that have been damaged or destroyed by anything that we could lay to high-potential discharges.

A Member—Do you have any lightning troubles in this immediate district?

The Chairman—Not around the bay; away back in the mountains, where we get into the higher altitudes, we do have some; but that is confined to the mountain district.

Mr. Lissberger—We have had some in the Palo Alto district, in lightning storms, on the eleven-thousand-volt line, and also on the twenty-three-hundred-volt. There is something peculiar about the multigap arrester. That is the question of the condition of the atmosphere with reference to humidity. I have seen multigap arresters do all sorts of things, dependent entirely upon whether the air was dry or whether it was damp. Some of the first arresters that I saw, some years ago, had a double holding piece; in other words, they had a top and bottom, to hold the cylinders together. Those were made of slate, and in damp weather I have seen the static disturbance or discharge become greater and greater and greater, until, finally, after twenty minutes' or half an hour's rain, the slate was so hot you could not hold your hand on it, and at the end of that time the arrester, which was holding back the discharge, would completely break down. The same result did not occur in marble. I know of one extreme case where lightning broke the top of a transformer. The question of putting air switches and buses outside of buildings was mentioned to-night. I think just a little while ago it was suggested that the station buses be put outside of the building. If you will contemplate the possibility of a kite dropping into your buses, it will knock all consideration of that proposition out of your mind.

The Chairman—Mr. Miller, can you give us something on the question?

Mr. Miller—I do not think I can add anything. Mr. Burkett has outlined our practice very clearly.

The Chairman—Has anybody else anything else to say on the subject?

A Member—I would like to ask Mr. Bowis if he intends to use this new circuit-breaker on the line; I suppose he intends to use the oil switch?

Mr. Bowie—The circuit-breaker is intended to be used in place of the oil-breaker used now.

The Chairman—If there is nothing else, I expect that we will stand adjourned until the next meeting.

COMMUNICATED BY LETTER.

By A. J. Bowie.

With reference to the location of switches, I am a firm believer in installing out of doors, in series with each outgoing line, an efficient switch capable of breaking the short-circuit current of the line. A suitable switch, installed outside, and controlled from within, avoids the need of switches, both inside and outside. It cannot be considered good engineering to install plants, operating under high voltages, and feeding through pole-lines, without outdoor switches to disconnect the line wires. This applies not only to sub-stations, but also particularly to generating stations, electrically connected to other generating stations. It is by all means advisable to be able to kill the high-tension wires entering the station from

switches at the station, and if proper outdoor switches are not provided, an accident to these wires may have very serious consequences.

An air switch with a visible break and without possibility of the leakage of current which may be dangerous to life, through the surrounding medium, offers the best solution of the problem of line switches, being always open to immediate and continuous inspection, and not requiring the operation of a double set of air disconnecting switches before it can be even examined. The space requirements of air switches are greater than those of oil switches alone, but when account is taken of the air disconnecting switches which must be installed with the oil switches, and of the large amount of room required for the high-tension wiring leading to the oil switches, the reverse is usually true.

Moreover, the cost of the building for housing the latter, with the necessary fireproof partitions, forms a surprisingly large part of the real cost of the switch, while, in most places where high pressures are employed, real estate is of very little value, and the cost of land required for air switches is inconsiderable.

I do not agree with the statement that the arc in an air switch causes a deformation of the form of current wave. On the contrary, the arc acts merely as a resistance, and being non-inductive can neither cause deformation of the wave, nor can it give rise to harmonics. It serves a very useful purpose of introducing a high resistance into the circuit, and hence cutting down greatly the current, and reducing to a minimum the strain caused by opening the circuit.

As I pointed out, the results of other engineers fully support this contention, not to mention my own experience.

For the last four years, more switches of my design have been in practical operation in many parts of the country, and I have as yet to hear of the first instance where opening the switch caused sufficient voltage rise to make the lightning arresters discharge. This shows conclusively that no dangerous potential rise accompanies the operation of properly-designed air switches.

With reference to the operation of circuit-breakers, oil circuit-breakers, as has been shown, necessitate the most rigid construction, both to withstand the necessary pressure, and to open the circuit instantly. The air circuit-breaker does not require such instantaneous action, as ample provision is made for taking care of the heat of the ensuing arc. Hence the requirements are not so severe, and the expense of manufacture of the air breakers, with an equal mechanical and superior electrical efficiency, is less than that of oil breakers.

ATTITUDE OF THE LAW TOWARD ELECTRICITY.

By Emerson W. Read.*

A street-car company using overhead wires makes use of an agency more than commonly dangerous. The danger attendant upon the breaking and dropping of charged wires which are strung over a public thoroughfare is so evident and so great that in Memphis St. Ry. Co. v. Kartright (110 Tenn. 277) the Court held the company to the "highest and utmost degree of care in the construction, maintenance, and operation of its lines." As a result, the company was compelled to use the "best material, the most approved methods of construction, and the highest degree of care and skill in maintaining and keeping the same in repair."

In California, wires must be elevated on roof-tops beyond any probable contact point. The plaintiff, in Giraudi v. Electric Imp. Co. (107 Cal. 120), was a dish-washer in a restaurant, the wires to light which ran about sixty feet over the roof of the building, at an average height of two feet. Plaintiff had seen the servants of the company placing the wires, and had been upon the roof in the day-time when the wires were in position. The night of the accident was stormy, and plaintiff, with his employer, went upon the roof to secure the business signs of the latter. Plaintiff, not knowing or forgetting the location of the wires, came in contact with them. Held, that defendant was negligent in not raising the wires so high above the roof that those having occasion to go there, would not come in contact with them.

But contributory negligence on the part of the injured plaintiff may bar a right of recovery against a negligent electric company. So, too, such a company is not an insurer against accident caused by its wires. Stringent as the law may be relative to electricity, electric companies are not liable absolutely for injuries done by its wires. A peculiarly striking instance of this occurs in Wood v. Diamond Electric Co. (185 Pa. St. 529), where plaintiff was refused damages for injuries suffered by him when, to prove the correctness of his views on the absence of danger in a passing wire, he touched it with his hand. However, no contributory negligence existed when Griffen touched an insulated wire where the insulation had been worn off, he not knowing it was an electric wire, nor that it had been damaged (Griffen v. United Electric, etc., Co., 164 Mass. 492).

It can plainly be seen that a company which stretches its wires in a public street erects a more dangerous structure than one erected on a private property. In streets, as the danger is great, proportionately great must be the care of the company in guarding the public (Gannon v. Laclede Gaslight Co., 145 Mo. 580). Travelers in public thoroughfares have a right to assume that the highway is free from dangerous obstacles. No company can contend that a traveler on a highway should expect to encounter hanging "live" wires. That such a person should come in contact with an electric wire lying in the street is not, of itself, evidence of contributory negligence on the traveler's part (Hovey v. Mich. Tel. Co., 124 Mich. 607). Very recently, however, in California, it was held that a traveler on a county road, who attempted to remove a power cable which had fallen across the road, by means of a halter thrown over it, was guilty of contributory negligence, the current killing by conduction. The evidence in the case plainly showing that deceased had used the halter by way of precaution and not at any time permitting any part of his body to approach within a distance of one foot of the cable (Cal. Sup. Adv. Ss.). And contributory negligence was attributed to a brakeman who, aware of an electric wire hanging low over passing box-cars, attempted to pass thereunder over the tops of the moving cars when there was no imperative necessity to justify the risk (Dansville St. Car Co. v. Watkins, 97 Va. 713). Contributory negligence also barred the action of an experienced employee of an electric company, who neglected to use his rubber gloves and was injured by grasping an electric cable plainly not insulated (Junior v. Missouri Electric Co., 127 Mo. 79). And a lineman is sufficiently warned of danger about an insulated wire on which the insulation had been chafed away for a distance of two feet (Columbus R. R. Co. v. Dorsey, 46 S. E. 635). Nor can one recover who absolutely disregards the warnings of his employer (Tri-City Co. v. Killeen, 92 Ill. App. 57).

*B. L., L. L. B., member of the San Francisco Bar.

JOURNAL OF ELECTRICITY POWER AND GAS

"From the Rockies to the Coast."

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President

E. M. SCRIBNER, Vice-Pres. and Gen'l Manager.

A. H. HALLORAN, Secy. and Managing Editor

Directors:

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C. L. CORY E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot commence with back numbers.

Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1905, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX JUNE 20, 1908 No. 25

CONTENTS.

In our next issue Frank G. Baum suggests a Government Policy for the Control of Water-Power Development in the National Forests. It is likely that there will soon be a conference of electrical men to discuss this.

Peter Murman writes on "Credits and Collections" as applied to electrical contracting.

EDITORIAL.

POWER PLANT DISASTER.

As noted elsewhere in our columns, the Cazadero Power Plant of the Portland Railway, Light & Power Company, has been wrecked by means of heated segments thrown by centrifugal force from runaway generators. The main generators and governors were broken and subsequently the power house was burned, primarily because the ungoverned turbines ran free and attained a peripheral speed equal to the spouting velocity of the water. The accompanying suggestions from Mr. W. H. Dix, Western representative of R. Thomas & Sons, offers a rational explanation of the accident:

"That there should have been such damage is due to the fact that the engineers who were responsible for the equipment of the plant, overlooked the necessity of advising the manufacturers of the generators of the runaway speed of the turbines, and of obtaining a guarantee that the machines should be designed mechanically to withstand the action of centrifugal force at that possible maximum speed. Specifications were so drawn as to cover this contingency in two power plants with the design of which the writer was concerned. In one, the generators were 1,000-kilowatt normal capacity, at 120 revolutions per minute, maximum head 17 feet; in the other, 3,000 kilowatt units at 240 revolutions per minute, maximum head 60 feet. In both cases the peripheral speed was about two-thirds the spouting velocity from which the 'runaway' speeds were easily ascertained."

This suggestion seems necessary, not for designing engineers, but to reassure investors and operating staffs as to the safety of power plants. We hope for further facts upon which to base more detailed comments in an early issue, as this accident seems unique in electrical annals.

SITUATIONS WANTED.

There are few things more disheartening than a wearisome search for work during a time like the present, when a halt has been called in the progress of many undertakings. As a result of the financial depression, many good men have been thrown out of employment. Leaving the outlying towns and camps, they come to the large cities, and there meet many in the same plight.

As a rule, the technical man is more fortunate than the unskilled artisan. His savings during the preceding good times enable him to live comfortably, and even enjoy a long-deferred vacation. But the fact that he has met with such misfortune should teach several lessons, the first and most important being a realization of the advantages of having previously kept closely in touch with his acquaintances. Good positions often go begging because the availability of the right man is not known. But through correspondence one's need becomes his friends' pleasure to remove.

A good letter is often as effective as a personal application for a position. Many electric companies have files to which they refer when about to fill a vacancy. It is suggested that a man should write to several concerns, stating his experience and qualifications. These letters will be preserved, whereas a manager may be too busy to entertain a personal application.

Another successful method is to write for publication in the engineering press. Any previous work contains points of interest to fellow workers. It is more than a coincidence that most of the leaders in the engineering profession to-day have been frequent contributors to the technical press. An account of what one has done suggests your usefulness in similar work. The ability to give a lucid, concise account of the various phases of one's work, indicates clear thinking, and incidentally it often shows how little one really knows about a subject, and tells the points in which one is deficient. These deficiencies may be remedied in an interval like the present. Obscurities can be cleared and the student better equipped to master the difficulties of the morrow.

In the course of a recent address at Cornell University, Director Smith, formerly of Stanford University, plotted a curve, using as abscissae, years of experience, and as ordinates, degrees of achievement. He showed that each man has a possible curve which his achievements may approximate, but never coincide. Because one man's curve is lower that a second's, and higher than a third's, is no reason for either discouragement or self-laudation. Every endeavor should be to keep its course upward. Now is the time to recognize and remove the limitations that have governed the curve's form.

PERSONAL.

C. C. Hillis, of the Electric Appliance Co., left Thursday on a trip East, being accompanied by his family.

Walter Robbins, assistant general manager of the Wagner Electric Co., of St. Louis, sailed on June 20, for a six months' ocean voyage.

R. J. Martland has given up the active direction of the Martland Electric Works of San Francisco to engage in the automobile business in Oakland.

George Carson has been promoted from division inspector to claim agent of the Seattle Electric Co., succeeding C. A. Hammond, resigned.

H. F. Frosch, of the H. F. Frosch Company, San Francisco, exclusive representatives of the Federal Electric Co., left for a trip throughout the East on June 25th.

Taliaferro Milton, sales engineer of the Electric Storage Battery Co., covering the Northwest, has located permanently at the San Francisco office of the company.

Tracy E. Bibbins, manager San Francisco supply department General Electric Co., has returned to San Francisco after an extensive trip East. He states that all signs indicate a return of good times.

H. B. Squires, of Otis & Squires, of San Francisco, writes from New York that he finds the effete East much too warm for his taste and wishes he were back in dear dusty windy old San Francisco.

E. Ward Wilkins, whose last trip to the Coast in the interest of Partrick, Carter & Wilkins is so pleasantly remembered, is planning to make another visit here within the next month. Old friends look forward with pleasure to renewing former acquaintance.

A. E. Drendell, of the Drendell Electric Company, met with a serious accident while driving an automobile near Watsonville last week, but owing to his vigorous constitution he has passed the crisis and will probably recover from his injuries. Peter Decker, of the Decker Electric Co., was in the same machine, but escaped with a severe shaking up.

E. M. SCRIBNER GOES EAST.

E. M. Scribner, vice-president and general manager of the Technical Publishing Company, started this week on an extended trip East, in the course of which he will visit nearly every Eastern electrical manufacturer. Before his departure his former associates at the Western Electric Company presented him with a complete golf set. In the presentation speeches their regrets at his severing the pleasant relations which had always marked his management of the Western Electric Company's interests on the Coast were compensated by the thought that his new work would follow similar lines.

TRADE CATALOGUES.

Bulletin No. 4588, just issued by the General Electric Company, Schenectady, N. Y., describes the GE-202 railway motor, which is similar in design and construction to the latest standard GE railway motors, containing all their improvements and, in addition, being provided with commutating poles. The characteristics of the commutating-pole motor allow the overload to be considerably increased and at the same time a more rugged form of motor is obtained, which will withstand the most severe service conditions, and is less likely to be injured by misuse.

The General Electric Company, Schenectady, N. Y., describes in Bulletin No. 4586 a new lamp containing many novel mechanical features and of particularly simple construction. The lamp is of short length, being only thirty-one inches from top to bottom, and is intended for operation either in series or in multiple. Among some of the advantages are the elimination of clock mechanism, accessibility of parts when the shell is lowered to the trimming position, and many special features of reliability inherent in the design.

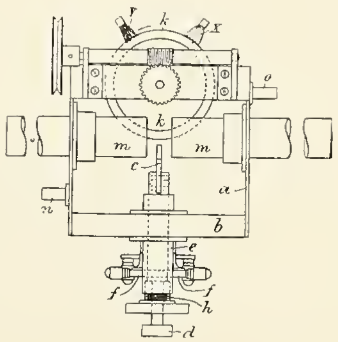
The Massachusetts Fan Co., Watertown, Mass., has just issued an exceedingly attractive booklet entitled, "Davidson Ventilating Fans." The illustrations show both pulley fans and many types of electric fans driven by standard motors of various makes. These are applicable for the economical movement of large volumes of air at moderate pressures.

The Electric Storage Battery Co., of Philadelphia, in Catalogue C, illustrate and describe "Car Lighting Cells." After showing the necessity for storage batteries in all car-lighting systems, it briefly describes the construction of the "Chloride" and the "Tudor" accumulators. Specifications and price lists for all styles and sizes are given, thus making one of the most complete publications on this line yet issued.

PATENTS

GENERATOR OF ELECTRIC OSCILLATIONS. 890,451. Valdemar Poulsen, Copenhagen, Denmark.

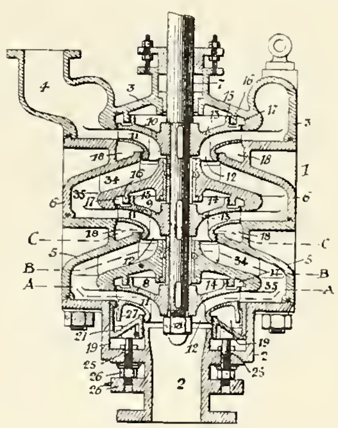
In an apparatus for generating electrical oscillations by means of an electric arc or the like, a circuit including



inductance and capacity, an electrode in said circuit, an electrode having a thin coating forming the actual electrode substance, and means for continuously renewing said coating.

CENTRIFUGAL PUMP. 890,355. Oscar Goeriz, San Francisco, Cal.

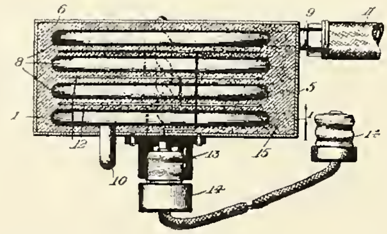
In a centrifugal pump, the combination of a casing having water-ways, a runner rotatable in said casing and communicating at its peripheral portion with said water-



ways, said runner having a suction-inlet, counter-balancing-chambers at the rear of said runner, an annular chamber in advance of said runner and communicating with the inlet and outlet thereof, and adjustable means to control such communication.

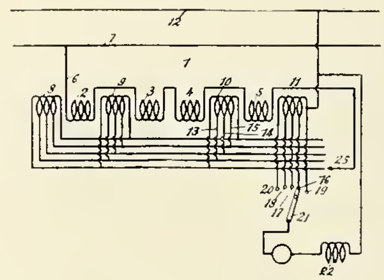
ELECTRICAL INSTANTANEOUS WATER-HEATER. 890,053. Louis C. Henriksen, Los Angeles, Cal.

An electrical water-heater comprising a metallic casing, a heat-conserving material completely filling said metallic casing, a water conductor comprising a plurality of coils arranged one above the other, and spaced apart from each



other within said heat-conserving material, an electrical conductor comprising a plurality of coils, one of said coils being positioned adjacent each of the water conductor coils, but spaced therefrom by said heat-conserving material.

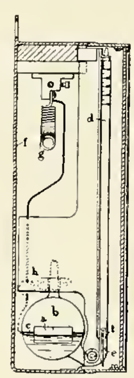
ELECTRICAL TRANSFORMER. 889,931. Svend E. Johannesen, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.



A transformer comprising a set of parallel-connected coils and another set of coils having one terminal connected to corresponding points of the parallel-connected coils, the members of the two sets of coils being alternately disposed with reference to each other.

ELECTROLYTIC METER. 889,929. George Hookham and Sydney H. Holden, Birmingham, England.

An electrolytic meter, comprising in combination a cell, electrolyte and gas in said cell, an electrode capable of absorbing said gas partly immersed in said electrolyte, a

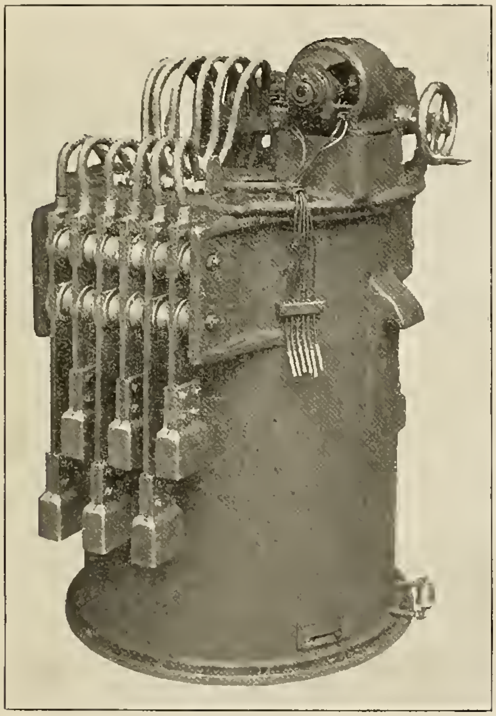


measuring chamber, a connection between the lower ends of said cell and said measuring chamber, said cell and measuring chamber being mounted on a hinge, as and for the purposes described

INDUSTRIAL

WESTINGHOUSE INDUCTION POTENTIAL REGULATORS.

The modern practice in central-station distribution of alternating current, is to maintain a constant potential on the station busbars, so that the feeders radiating therefrom are all supplied at the same voltage; and in order to secure good regulation throughout the whole system, means must be provided for regulating the voltage on each feeder. The voltage drop in any feeder depends upon its arrangement, sectional area and length, and upon the amount and power-factor of the load that it carries. The time-load curve of each feeder must also be considered in comparing the voltage drops on several feeders, as it is evident that these curves may vary widely, even when the average loads on the feeders are approximately the same.

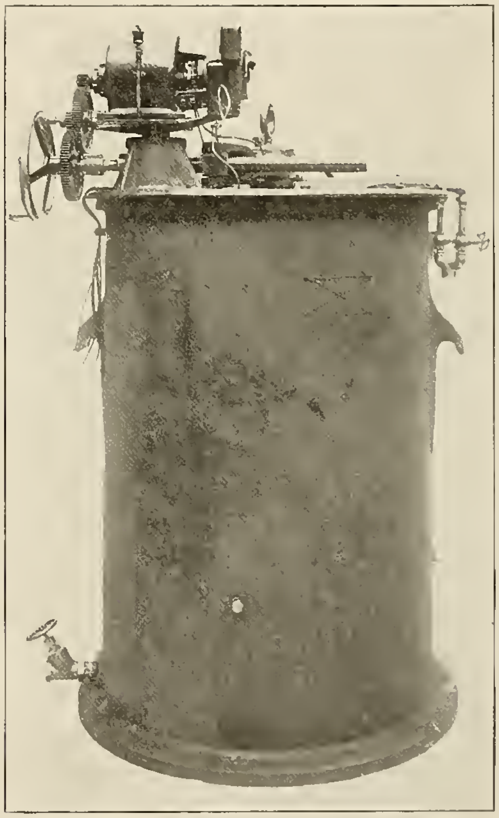


SIX-PHASE AIR BLAST INDUCTION REGULATOR MOTOR OPERATED, FOR USE WITH SIX-PHASE ROTARY CONVERTER.

Owing to the variable conditions of load, it is apparent that good regulation can only be provided by compensating for the voltage drop on each feeder, independently of all the others, and it for this purpose that potential regulators were primarily designed.

The induction type effects the regulation of a single-phase circuit by altering the position of a coil in a magnetic field, thereby changing the magnetic flux passing through the coil. The single-phase regulators are generally used on feeder circuits supplying electric lights, and the polyphase regulators are used in connection with rotary converters, and on feeder circuits supplying power either with or without lights.

The regulator resembles an induction motor in general construction. It may be either self-cooling or cooled by an air blast or by water-cooling coils, depending upon the size and design. The standard single-phase regulators up to 55-kilowatt capacity, are oil-immersed and self-cooling. These regulators are arranged for manual operation, or may be made for automatic operation. The automatic regulators are generally operated by a small single-phase motor controlled by a volt-meter relay so that the only power used is the alternating current obtained from the feeder itself. This regulator is therefore well adapted for placing in sub-stations, as it requires little or no attention beyond occasional inspection and cleaning of the relays.



WESTINGHOUSE POLYPHASE MOTOR OPERATED INDUCTION REGULATOR.

The operation consists of the primary or energizing coil sending a magnetic flux through the secondary or series coil. This causes the voltage in the latter winding to change, depending upon the amount and direction of the magnetic flux passing through the winding. In the middle or neutral position, the two windings are at right angles, so that the primary has no effect on the secondary winding, and therefore has no effect on the voltage of the circuit. By rotating the primary either way from the neutral position, a voltage is impressed on the series winding which either increases or decreases the feeder voltage. This action is analogous to that of a booster on a direct-current circuit.

The primary and secondary consist of iron punchings wound for two poles. If the winding were distributed in an infinite number of slots, the resulting voltage would follow the sine curve. As the number of slots decreases, the voltage curve has an increasingly irregular shape, which reaches a maximum with a one-slot coil. The Westinghouse regulators are designed with a sufficient number of slots in both the primary and the secondary, so that the voltage curve approximates a sine curve very closely and gives the best results in regulation.

When the regulator is in its neutral position, the primary does not induce any voltage in the secondary, and the latter, therefore, tends to create its own field and act as a choke coil. This condition is overcome by providing the primary with a short-circuited winding which is placed at right angles to the exciting winding. The short-circuited winding comes into play when the exciting winding approaches the neutral position, and it acts similarly to a short-circuited secondary of a series transformer, so that practically no choking effect is evident in the secondary or series coils. If the short circuited winding were not used, the voltage necessary to force full load current through the series winding would increase as the regulator is moved from the position of maximum or minimum voltage regulation, reaching a maximum when the regulator is in the neutral position. Since this voltage is at right angles to the working voltage, the result would be a poor power-factor in the feeder circuit. The short-circuited winding so cuts down this voltage of self-induction, that the voltage necessary to force full load current through the secondary winding when the regulator is in position of zero boost is very little more than that necessary to overcome the ohmic resistance of the secondary coil. The question of vibration requires very careful consideration in the design of this apparatus, and the Westinghouse single-phase induction regulators, owing to their excellent design, show practically no vibration.

The polyphase induction regulator is similar to the single-phase regulator, except that both the primary and secondary elements are wound with as many sets of coils as there are phases in the circuit. These windings are distributed throughout the complete circumference of the cores, and closely resemble the windings of an induction motor.

The polyphase regulators, when built in large sizes, are oil immersed and water cooled. The small sizes, however, are generally oil immersed and self-cooled.

Polyphase regulators have but little tendency to vibrate, because the field across the air gap is the resultant of two or more single-phase fields and is of a constant value at all times. This field rotates at a rate depending upon the number of poles and the frequency of the circuit. This produces a mechanical pull of constant value which rotates with the magnetic field, varying its position from instant to instant. It is evident that this pull is of an entirely different character from that produced by the single-phase field, and that there is no tendency to set up the vibration that the mechanical pull of the single-phase regulator tends to establish. There is, however, considerable torque developed, and the device for rotating the primary must be liberally designed so as to withstand the excess torque caused by temporary over-loads or short-circuits. Further details of induction and step-by-step potential regulators are given in Circular 1017 from the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa.

PELTON AUTOMATIC NEEDLE NOZZLE.

Notwithstanding the general business depression so universally complained of, the Pelton Water-Wheel Company report that their San Francisco shops are under contract to deliver water-wheels aggregating 38,000 horsepower, practically all of which are intended for hydro-electric developments. The following transmission companies are reported to be large purchasers:

Northern California Power Company,
Summit County Power Company,
Ruby Gulch Mining Company,
Kekha Electric Co. (Hawaii),
Northern Light & Power Company, and
The Nevada-California Power Company.

The water-wheels for the latter company's plant will be equipped with Pelton automatic needle nozzles, designed to discharge water in practically direct proportion to the power developed. Heretofore the question of water economy in hydro-electric plants has usually been disposed of by adopting "combination needle and deflecting nozzles," used in connection with storage reservoirs located at or adjacent to the pipe-line intake. Plants carrying rapidly-fluctuating loads suffer the loss of considerable water with this type of nozzle, unless the station operator is constantly at the needle valve to vary the jet area corresponding to load changes. With the automatic needle nozzle the services of the operator for this duty may be dispensed with, since the action of this nozzle is automatic and controlled primarily by a small speed governor. Simplicity, efficiency, reliability, and satisfactory speed regulation are the essentials entering into its design. By its use lighter-powered governors than heretofore employed may be used, thereby increasing governing results and reducing first cost. Fluid cylinders (either oil or water) furnish motive power, their action being dependent upon the travel of small pilot valves which in turn are controlled by the speed governor. The latter is not called upon to furnish energy for the movement of nozzle parts other than the pilot valves.

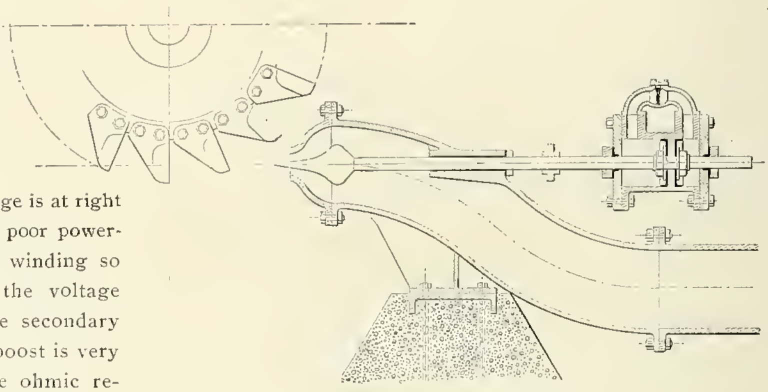


FIG. 1. CROSS SECTIONAL VIEW SHOWING PARTS OF THE "PELTON AUTOMATIC NEEDLE NOZZLE."

A device for preventing undue changes in pipe-line velocities has been introduced, a fault heretofore not satisfactorily overcome with automatic water-wheel nozzles. Briefly, the action of the Pelton automatic needle nozzle is as follows, say, for example, an impulse wheel unit is delivering to an alternator 2,000 maximum horsepower. As the load fluctuates below this amount, the cycle of operations of the automatic nozzle would be substantially as follows:

1st. Action of speed governor causing movement of pilot valves admitting oil to cylinder connected to the jet-deflecting mechanism.

2nd. Immediate deflection of water jet, tending to cause a return of water-wheel to normal speed.

3rd. Co-incident with the deflection of the water jet (operation No. 2), a second oil cylinder attached directly to the needle-stem slowly causes the needle valve to close, reducing the jet area to a point corresponding to the load carried for the particular period of time.

4th. Synchronously with the outward movement of the needle nozzle, the deflecting mechanism is drawn out of the path of the jet.

The above cycle of operations take place within a few seconds, the time element depending upon the safety factors of the pipe-line, and the allowable variation of velocities in same. To be of any practical value, it is essential that the deflecting mechanism must be out of the jet the maximum amount of the time to effect water economy. The above operations take place upon the water-wheel dropping a portion or the whole of its load. When the reverse takes place, that is to say, when the wheel is developing, say, 500 horsepower and a sudden call comes for 1,000 horsepower, the ports in the needle operating cylinder being larger, permit a rapid backward motion of the needle valve. In no way is the efficiency of the water-wheel altered, and, in addition, the very highest water economy is obtained without jeopardizing the safety of the pipe-line or without sacrifice to speed regulation. The illustration, Figure 1, shows a cross sectional view of the automatic needle nozzle. Many of the essential details, however, are lacking from the engraving, such as the stream deflecting mechanism and relay return device, and speed governor. These nozzles may be used in connection with any make of impulse water-wheel, and their use is bound to be of great value to hydro-electric plants possessing water-storage facilities.

ALLEN AGENCY GIVEN TO OTIS & SQUIRES.

The Pacific Coast sales agency for the products of L. B. Allen Co., Inc., Chicago, has been awarded to Otis & Squires, 111 New Montgomery Street, San Francisco, California, who will carry a complete stock from which to make prompt shipments to anyone in their territory. The Allen line embraces soldering flux, soldering outfits, resin core solder, metal polish, frostings and colorings for incandescent lamps, and commutator lubricants.

Allen-Flux, as put up by the Allen chemists in various forms, is free from acid. In electrical work, therefore, it is absolutely a requisite as it does not destroy insulation, and does not cause power losses or short circuits, hitherto serious consequences from the use of acid flux. To suit the various kinds of soldering operations, Allen-Flux is put up in four forms—stick, paste, salts and liquid—to afford convenience in application. It has been on the market sixteen years, and has been extensively used, it being regarded as the standard. Its peculiar and distinct application and excellence in the electrical field has called forth the commendation of electrical experts, elicited the approval of the U. S. Government and received the official endorsement of the National Board of Fire Underwriters.

L. B. Allen Co., Inc., publishes a tasty little book, entitled, "If You Solder," which contains many valuable suggestions to those doing soldering, and who wish to improve their operations along the most advanced lines. This book can be obtained free of charge by addressing the company or their agents.

UNION GAS ENGINE PLANT.

The accompanying illustration shows the manufacturing plant of the Union Gas Engine Company, Inc., which was originated and developed in San Francisco, and is a pioneer in the manufacture of gas engines, fuel conditions having favored their perfection and introduction for marine purposes on this coast, far in advance of other localities. The factory is in East Oakland, where they have six and a half acres of land, with dock and deep water on the Estuary. The Belt Line Railroad crosses the property in the rear of the buildings, giving unexcelled facilities for receiving material and shipping products. The buildings are large and substantially built, with good light in all departments, and comprise a machine and erecting shop, 130x200 feet; pattern shop, 100x40 feet; testing house, 36x82 feet; blacksmith shop, 25x36 feet; brick pattern store house, 40x100 feet. There is also a tank tower with 40,000 gallons of water above sixty-five foot pressure, and complete system of fire protection. The main bay of the machine shop has a fifteen ton electric traveling crane, and in the same building are two ten-ton and six five-ton traveling cranes, and a number of jib cranes. The test house and blacksmith shop are also fitted with these indispensable conveniences. All the shops and the dock are connected by a railroad, with turntables, so that engines in process and finished goods for shipment can be handled with ease and rapidity.

The shops are equipped with latest improved machinery, bought since the fire destroyed their old plant in San Francisco. At the present time they are employing about 175 men, and expect to increase this number to 250 this fall. The Union Gas Engine Company has specialized on high grade gas engines for working boats, and are prepared to furnish these from 2 to 500 horsepower. They have recently perfected designs for a new line of horizontal stationary and hoisting engines, which they will put on the market this fall. Agencies have been established in all parts of the world. The company has recently opened a large store at 503-505 Mission Street, San Francisco, believing that the rapid return of trade to the machinery district justifies their doing so.

PLANT OF THE UNION GAS ENGINE COMPANY.

NEWS NOTES

POWER AND LIGHT.

Wenatchee, Wash.—The City Council last night decided to advertise for power to run the new pumping plant.

Aberdeen, Wash.—The Grays Harbor Gas Company has commenced work on repairs to its plant which, when completed, will have cost about $5000.

Spirit Lake, Idaho.—At a meeting of the Board of Trustees held after receiving reports from the various officers, the council authorized the installation of fifteen 6-ampere arc lights.

Pasadena, Cal.—The Pasadena Consolidated Gas Company will soon extend their 16-inch cast-iron gas-pipe line southward to company's plant and northward as far as the number of consumers warrant.

Vancouver, Wash.—The Portland Railway, Light & Power Company has secured a franchise from the county commissioners to string poles and wires for lighting purposes through the Fruit Valley section.

Phoenix, Ariz.—A number of progressive citizens of which H. L. Chandler is at the head, have the matter of the installation of a gas plant for this place and Tempe under consideration. Such a plant could be put in for $50,000.

Seattle, Wash.—J. H. Van Asselt of Seattle has applied for a gas franchise at Georgetown. He states that he and associates have all money needed for building the plant and they propose to supply Georgetown and such portions of Seattle as are in the vicinity.

Bremerton, Wash.—The City Council has granted to Ezra Norman a franchise permitting him to erect a gas plant in Bremerton. He will sell the illuminant at $1.35 a thousand feet. Norman agrees to lay one mile of mains within a year.

Hailey, Idaho.—The Independence Mining Company closed a contract with parties in Hailey to supply the poles for a 14-mile power and light line extending from the Cramer Electric Company's works at Hailey to the mill and mines of the Independence Company, in Independence Gulch.

Vallejo, Cal.—Permission has been secured from the city by the Vallejo Gas Company to lay a 6-inch main up Sonoma Street from the gas works at Maryland Street to Capitol, and also up Marin Street from Maryland to Capitol, and on Capitol to connect the Marin and Sonoma Street lines.

Santa Monica, Cal.—Installation of an ornamental lighting system on Ocean Front Walk between Pier and Hollister Avenues at the expense of the city's general fund is threatening to make trouble. The City Council has awarded a contract for ornamental posts, but a protest has been presented, claiming that citizens should pay for the expense of the posts instead of the city.

WATERWORKS.

San Jose, Cal.—The estimate of the cost of a water system is $25,000. These figures were discussed by the Board and will be submitted to a mass meeting to be called in a few days.

Oakland, Cal.—Judge Murasky has set for hearing June 30th the suit of the Contra Costa Water Co. against James B. Barber, tax collector of Alameda County, contesting the validity of an assessment of some of the properties of the corporation. The amount involved is close to $100,000.

San Francisco.—A contract for furnishing 5-inch hydrants has been let to Castle & Co., that firm being the lowest bidder on this particular sized hydrants. The contract for 4-inch hydrants has been divided between Castle & Co. and the Benicia branch of Baker & Hamilton, who each offered bids of $49.

Reno, Nev.—Col. W. C. Rose, a wealthy resident of Tonopah, has cornered the unappropriated water supply of Humboldt County. His plan is to use the water for the development of electricity and furnish the power to the Seven Troughs mining district camp. He announced that he has enough water to create 5000 horsepower.

Alameda, Cal.—Councilman Probst is preparing plans to present to the Alameda City Council for the installation of an auxiliary salt-water fire system. According to the plans, the power is to be furnished by the Municipal Electric Lighting Plant. The Alameda Advancement Association has endorsed Councilman Probst's idea and also suggests that the lighting plant be moved to a more central location.

San Francisco.—Bids have been opened for the construction of a pumping station and reservoir for furnishing the Presidio with a pure water supply from Lobos Creek. So many bids were submitted that the amounts cannot be ascertained for several days. Twenty-one firms, most of them local companies, bid for the work, which will represent an outlay to the government of approximately $120,000.

Oakland, Cal.—Inspection of the watershed of the People's Water Co. at Lake Chabot was made by the Board of Health recently. The inspection covered all the shed surrounding the lake and its tributaries. Dr. Dukes said that the party found that conditions were good; that first-class attention had been paid to observing the law against contamination of the watershed. No campers were permitted in the restricted territory and vigilance was manifested in the general watching of the drainage region.

McMinnville, Ore.—The McMinnville Local Long Distance Telephone Company, capital stock $20,000, which was subscribed by local people and the De Varney-Waggoner Company, of Portland, was organized here recently. It is the intention to construct a long-distance line from Portland to McMinnville.

FINANCIAL.

Sausalito, Cal.—The trustees have introduced a resolution preliminary to calling an election in August to bond the town for $100,000 for installing a municipal water distributing plant in North Sausalito.

Los Angeles, Cal.—The following is the statement of the business of the Edison Electric Company of Los Angeles for the month of May: Gross earnings, $184,784.86; operating expenses, $107,430.75; net earnings, $77,354.11; fixed charges, $51,390.99.

Santa Cruz, Cal.—Ordinance dealing with the matter of calling for the creation of a bond issue for the bonding of the city for the enlargement of the water system and electric light plant and other purposes, has been passed by the City Council.

Gridley, Cal.—At the meeting of the City Trustees June 15th the ordinance providing for an election on the question of a $33,000 bond issue for municipal water and electric lighting systems was again discussed. At a later meeting the ordinance was adopted and the election was set for July 13th.

Vallejo, Cal.—At the meeting of the Board of Trustees, held June 17th, the $85,000 in bonds, recently voted by the people for the construction of an additional reservoir at the municipal waterworks, was sold to the firm of E. H. Rollins & Sons of San Francisco, their bid the only one submitted offering a premium on the issue.

Los Angeles, Cal.—J. F. Sartori, president of the City Gas Company, has issued a statement in which he admitted that negotiations are pending between his company and several different large financial interests with a view to obtaining funds needed to extend and enlarge the City Gas Company's plant, or to selling a controlling interest for the same purpose.

San Francisco.—Notice has been given that the Mercantile Trust Company of San Francisco invites bids for the sale to it on July 21st of a sufficient amount of first consolidated mortgage 5% sinking fund 30-year gold bonds of Bay Counties Power Company for the investment of $23,177 now in the sinking fund. Each bid must state the serial numbers of the bonds tendered and the price asked and must be delivered to the trustee at its office, 464 California Street, San Francisco, on or before 3 p. m., July 6th.

Los Angeles, Cal.—The leading stockholders of the Mount Diablo Oil, Mining and Development Company have pooled their holdings, placing the same in the hands of five trustees, viz.: James Cullingham, J. W. Jameson, C. E. Stoner, F. M. Worthington, A. B. Greenwald, Frank Blessington and Alecq Fraser. The certificates are placed in escrow in the Merchants National Bank of Los Angeles, the agreement going into effect upon the deposit of 51 per cent of the outstanding shares and to be returned if this amount is not deposited by July 21st. About 60 per cent is already in. The terms are that a sale may be made on the order of five trustees at not less than $2.50 a share, if the action be approved by a majority of the stock in the pool. It may be disposed of for less if sanctioned by 80 per cent of the pool. The agreement is for two years from July 1st, when, if not sold, the shares will be returned.

TRANSMISSION.

Modesto, Cal.—An arrangement has been reached by which the application of the La Grange Water & Power Company for a franchise for an electric power and light line will be granted.

Merced, Cal.—It is ordered by the Board of Supervisors that the Yosemite Dredging & Mining Company be given permission to erect poles along the west side of the Upper Snelling and La Grange public highway.

Oakland, Cal.—The Tuolumne Water Power Company which is seeking to extend power lines from Tuolumne County to San Francisco has commenced suits in Oakland to condemn rights of way across property near Mission San Jose.

Seattle, Wash.—A contract has been awarded to the Star Electrical Company of Binghampton for installation of a manual and automatic fire alarm system for $42,994. The Gamewell Company offered to install same type of plant for $50,750.

Tacoma, Wash.—By a resolution the City Council has authorized the commissioner of public works to advertise for bids on furnishing the city with a water-power plant of 10,000 horsepower capacity and capable of further development to at least 20,000 horsepower.

Los Angeles, Cal.—The Board of Public Works will receive sealed bids up to 2 o'clock p. m., June 26th, for furnishing the city machinery and electrical equipment for tunnels, consisting of compressors, blowers, air receivers, transformers, motors, oil switches and meters.

Reno, Nev.—A representative of Pittsburg and Chicago capitalists has given out the information that in a short time work will commence on electric light and power plants on the Truckee and Carson Rivers, to supply power for a company to be known as the Nevada Gas & Electric Company.

Klamath Falls, Ore.—High officials of the Harriman lines recenty made a visit to the site of the proposed big power plant which is to furnish power for the operation of electric locomotives on the Southern Pacific mountain division. The plan involves building of a canal for two miles, sufficient to carry the entire flow of the Klamath River. Six hundred thousand horsepower electric current can be generated.

Portland, Ore.—An automatic governor on one of the floodgates in the Casadero power plant of the Portland Railway, Light & Power Company June 21st prevented the closing of the gate and started the generator connected to it to racing. The generator flew to pieces and one of the pieces of flying metal struck the governor to a second gate and started the second generator to racing. The second generator flew to pieces, causing a similar accident to the third generator, which likewise flew to pieces. Before disintegrating, the generators became excessively heated, and one piece of flying metal landed on the wooden flooring of an uncompleted portion of the building, setting it afire. All the woodwork of the building was destroyed. The loss is $110,000.

TELEPHONE AND TELEGRAPH.

Seattle, Wash.—A franchise for a telephone system at Des Moines, Wash., has been granted by the county commissioners to J. C. Elsey.

Steptoe, Wash.—A movement is on foot to improve and extend the farmers' telephone line now operating in this vicinity and connecting with Colfax.

Petaluma, Cal.—W. D. Thomas has been awarded a contract to build the Magnolia rural telephone line. The contract calls for sixty-four miles of wire and sixty-two telephones.

Kelso, Wash.—U. A. Wynn, representing the Northwest Independent Long Distance Telephone Company, has asked the council to give his company a franchise to erect a long-distance telephone system in the city.

Vallejo, Cal.—It is understood on the Mare Island yard that the equipment department of the local station will be ordered to prepare a wireless outfit for a new station at Valdez, Alaska. The station will probably be installed this year.

Cliffs, Wash.—Prospects are that a branch of the Columbus telephone line will be run to Cliffs during the coming summer. Mr. Manchester, the manager of the Columbus company, says they are making preparations to build several branch lines.

Merced, Cal.—It is ordered by the Board of Supervisors that W. E. Mitchell et al be granted permission to construct a private telephone line on the south side of the Merced and Turlock road, beginning at the city limits of Merced City and ending at the L. F. Herrod farm near Atwater.

Bellingham, Wash.—Telephone poles are being distributed along the road to Alger by the Home Telephone Company and within the next few weeks the automatic system will have another line leading into Skagit County. The line now being built will pass on through Alger to Belfast and Bellville.

Salem, Ore.—The Northwest Long Distance Telephone Company has petitioned the county court for a franchise to erect a telephone line and to cross the highway in several places with its line between Woodburn and Silverton. The application is signed by H. M. Friendly, superintendent of the company. W. E. Keyes is the attorney in the matter.

ELECTRIC RAILWAYS.

Salem, Ore.—The Oregon Electric has at last secured its franchise on Mill Street.

Juneau, Alaska.—An electric power station will be situated on Gastineau Channel to transmit power to the Ebner mine.

Seattle, Wash.—The Seattle, Renton & Southern Railway has completed negotiations for the sale of $1,000,000 worth of its bonds, from the proceeds of which the road is to be rebuilt at once. Extensions in the city of Seattle, under the franchises recently granted to the company, will be made, and construction started as soon as the Fourth Avenue and Dearborn Street regrades are completed.

Forest Grove, Ore.—A representative of the Oregon Electric Railway Company was in this city recently to see what action the citizens would take toward securing the right-of-way for an electric line. The Board of Trade met afterwards and selected a committee to interview the owners of property along the route which has already been mapped out, and it is thought no difficulty will be experienced in securing a right-of-way.

Seattle, Wash.—It was officially announced at the office of the Seattle-Tacoma Short Line this week that the final location of the projected double track interurban line between Seattle and Tacoma has been made, and that all of the right-of-way between Seattle and the town of Des Moines has been secured. The company has had men at work on the proposed grade just south of Youngstown since May 16th.

OIL.

Bakersfield, Cal.—The activity of the Standard Oil Co. in the Midway field has attracted the widest attention among oil men and there is much speculation over the meaning of its movements. The Standard is advancing large sums of money for development purposes with a view of purchase and is supplying water for drilling, all of which is a marked departure from the usual course of the company.

Bakersfield, Cal.—Development and production work is at a standstill in the Midway Oil District and producers are losing thousands of dollars daily in wages and production because of the failure to get water. There is scarcely a drop of water in the entire field except for the Standard and Santa Fe and their allies. Some companies have been closed down a week or more, some several days, the different superintendents coming to town after struggling in vain to keep their work in progress. The Producers' Water Co. is shut down; the Santa Fe has little to sell. The Oregon-Midway water wells, which it was thought for a time would help materially in solving the water problem, have proved a disappointment, and well No. 2, which it was expected would give several thousand barrels or more a day, has been a flat failure, and its production is said to be less than fifty barrels a day. This company also shut down and is installing a compressor by means of which it is hoped to augment the supply.

INCORPORATIONS.

San Francisco.—The Auto Ignition Company has been incorporated with a capital stock of $100,000, by R. S. Anderson, R. S. Ackerman and M. Oppenheim.

Manhattan, Nev.—Articles of incorporation have been filed for the Round Mountain Water Co., with a capital stock of $100,000. The incorporators are Thomas Wilson of Round Mountain and William Forman and S. K. Smith of Tonopah.

San Francisco.—Articles of incorporation have been filed for the Scott Creek Railway Company, capitalized at $50,000. The object of the company is to build 2½ miles of line from a point on the Ocean Shore Railway, at the Scott branch, to the San Vicente grant. The directors are J. Downey Harvey, John B. Rogers and Bert Corbet.